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Examining STEAM Education Programs within Art Museums: “A” is for Art Museums

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Examining STEAM Education Programs within Art Museums: "A" is for Art Museums

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Abstract

This case study considers the role that art museums can serve while using science, technology, engineering, arts, and math (STEAM) education. Through a qualitative inquiry, cases from literature are examined and opportunities are shared for best practices that art museums can use with STEAM education. This study not only advocates for art museums to include STEAM opportunities but also the collaboration between schools and art museums to be able to create these possibilities. Finding these concepts and ideas will show the unique position that art museums can play in STEAM education. This study will also share the influence in expanding and learning outside of the art classroom into communities. This inquiry involves the analysis of documents, interview reflections, as well as engaging in critical reflection.

Keywords: museum education programs, STEAM, STEM, art education theories and practices

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Chapter 1

Introduction

Every year, Cozad Middle School builds time into the schedule to offer classes centered around Science, Technology, Engineering, Art, and Mathematics (STEAM) education. The month-long classes allow students in sixth through eighth grade to choose their area of interest to explore. These classes, known as activity classes, are developed by teachers through STEAM education inspiration and range from robotics, sports statistics, coding, dissection, science fair, and art projects. While planning my class I began to question how I can support the needs of my students as well as include them in community connections. Exploring ideas of STEAM throughout our community led me to consider the local art museum's involvement with students and how they could enhance STEAM-inspired lessons.

Building this unique partnership between the art museum and the middle school, I aim to find and share ways for students to connect through STEAM-inspired exploration and gain a real-world concept of STEAM learning in action. Duerr (2008) noted that transdisciplinary learning, such as a STEAM curriculum, is especially important to middle school education. Students at the middle school age level are in the early process of becoming more independent and confident learners. Middle school students are also in a developmental phase where they are beginning to gain interest in careers and selecting or de-selecting career domains based on influences from family, peers, and educational experiences (Koszalka, et al., 2005). A strong influence in connections through art is also a developmental phase worth noting. Cozad Middle School students see art throughout their town daily, but very few have visited the local art museum. Allowing the students to explore and experience STEAM-inspired lessons will create

more engagement between the art museum and the school system, giving the students support in developing their interests.

As STEM has gained popularity in the past ten to fifteen years, the addition of "A" for the arts gives a more creative and artistic approach to help engage students, strengthen long-term memory, and aid in comprehension (Brigid, 2019). This study considers how art museums can support such integration as a new way to represent the "A" in STEAM. This research seeks to find out what type of STEAM programs art museums use and how the museums might collaborate with schools to engage students. Museums have a unique role in STEAM education and the role they can play in incorporating STEAM. This case study will examine and analyze best practices found for utilizing the art museum as part of STEAM-driven learning and form recommendations based on cases found to show what unique perspective an art museum offers.

The significance of this study is to share suggestions for best practices that connect STEAM education to art museum education programs. By doing so, schools and educators can use these suggestions while building a STEAM-inspired curriculum. Lessons involved with art museums and STEAM aspects will be analyzed and listed for further researchers to share with local art museums. Art is all around us, and incorporating art is becoming more and more evident in education. Students and staff are able to find and create real-world connections through incorporating art. Including the arts as well as art museums into STEAM-inspired activities creates an avenue for students to explore ideas from artists, composers, art history, scientists, mathematicians, and so on. Art students must be taught these ideas and teachers must learn how to utilize museum education programs in the art classroom and the museum setting.

Purpose Statement and Research Questions

The purpose of this qualitative inquiry is to analyze the unique role that art museums can play in STEAM education. The research questions that will guide this inquiry are:

1. How can museums impact student learning through educational STEAM programs?
2. How can learning be structured through the STEAM curriculum to be supported by art museums?

Chapter 2

Methods

This case study takes an in-depth look at how art museums may or may not use STEAM education to impact student learning. Creswell (2007) states that a *case study* examines an issue through a case or cases within a system such as a setting or context. Of the five qualitative approach methodologies a case study involves collecting and analyzing non-numerical information. The qualitative design requires research in a broad range of in-depth types of research and data collecting. To start this process, one must determine if a case study approach is the right approach for the research problem; "A case study is a good approach when the inquirer has clearly identifiable cases with boundaries and seeks to provide an in-depth understanding of the cases or a comparison of several cases" (Creswell, 2007, p. 74). Research is used to guide the questioning of the closely bound context or situation. The use of a case study allows one to observe and reflect on educational assets, as well as applications that may be out of the researcher's control.

Boundaries of the Case

In this study, I examine students learning through STEAM at the school at which I am employed. I also reflect on the past ten to fifteen years of art education and how the arts have

been incorporated into STEM and STEAM. Recollections from interviews with a colleague and a board member of the local museum are shared through summarizing. By including these interactions in this study, I can find how STEAM education can play a unique role in art museums. To include how art museums have been impacted by STEAM I look at studies and observations of previous scholarly articles who have researched the same issue.

My research focuses on the educational programs offered at art museums that use STEAM as a focus. Interviews used in this case study include the director of the local art museum, The Robert Henri Museum, as well as a coworker at the high school level. The visual organizer (Fig. 2.1) shows information about participants, the date of the interview, and the location it was conducted. The articles researched and information gained will help to find best practices and the research can help with creating a list of recommendations based on cases found. The use of a case study method will allow for observation, analysis, and reflection. This will guide the research to propose pedagogical practices that can help this system of education and create a STEAM connection between art classrooms and art museums.

Figure 2.1

Time, Date, and Location of Interview

Participants	**Date of Meeting**	**Location of Meeting**
Charles F Birgen – Board member, secretary, and docent at the Robert Henri Museum	11/2023	Phone interview
Trey Botts – High School Art Teacher	10/2023	Cozad High School

Self-Evaluation – Kylie Corkern	11/2023	Cozad Middle School

Data Collection Tools

In this study, I use three data collection tools: document analysis, interviews, and reflections through observations (see fig. 2.2). These three tools help to guide research to answer questions about STEM and its evolving ideas into STEAM, STEAM programs within art museums, and any connections that art museums have with using STEAM inspired learning in collaboration with schools.

- **Document Analysis –**I examine scholarly publications regarding the involvement of STEAM within art museums. I examine existing literature to look for recommendations for local museums that encourage and incorporate STEAM activities. Scholarly research journals, articles, and literature reviews help drive data with relevant material.
- **Interviews –** I share findings from my informal interviews regarding educational practices with STEAM activity classes and how a collaboration with local museums might look like and impact students.
- **Personal Reflections and Observations –** I reflect back on the ideas presented within literature as well as through interviews, I share my personal reflections on the research questions and my observations.

Figure 2.1.

Outline of Data Collection Tools, Purposes, and Sources of the Data

TOOLS	PURPOSE	SOURCE OF DATA
Personal Reflections/Observations STEAM activities in museums	To analyze the teaching and learning resources provided by or in collaboration with museum education programs.	PRIMARY SOURCES *Finding and comparing how STEAM is included in art museums in collaboration with schools
Interviews I share findings from my informal interviews in regard to educational practices with STEAM activity classes and how a collaboration with local museums might look like and impact students.	To informally reflect on ideas from interviews with Cozad High School art teacher and board member of the Robert Henri Museum	PRIMARY SOURCES *In-person interviews between two participants.

Document Analysis I examine existing literature to look for recommendations for local museums that encourage and incorporate STEAM activities. Scholarly research journals, articles, and literature reviews help drive data with relevant material.	Reflections on curriculums designed for STEAM-inspired activity classes and the involvement in educational programs.	PRIMARY SOURCES * This teacher/researcher reviewed the educational resources. SECONDARY SOURCE * Resources created for STEAM in art museums

Data Analysis:

The data that is collected throughout this research is analyzed through documents, learning strategies, and ideas to implement STEAM in art museums. By looking at other examples of strategies used the researcher will assess the outcomes through critical thinking and analysis as well as self-assessment and reflection. By sharing evidence-based conclusions, problem analysis, and areas of improvement for the research questions the researcher will conclude their ideas and connections moving forward.

Steps for the data analysis include an analysis of documents created to implement STEAM driven curriculum and the learning strategies for museum education programs. Looking at the learning strategies and deciding the effectiveness of the educational programs through the art museums. Finding clear expectations on outcomes and how it is essential for the development of the program. Sharing these strategies and what the analysis looks like as to what was examined. Then reflections and informal interviews results are recorded and analyzed to make decisions on the effectiveness of the curriculum design and the best practices found.

Limitations of the Study

As an art education graduate student as well as an art educator at the middle school level, this study is written in response to an opportunity that Cozad Middle School offers its students. As with many studies, the design of this study offers limitations. Not all middle schools offer such activity classes that are based on STEAM curriculums to their students. As an area of development, this could create a limitation of external validity with the study. Another limitation would be the differences of urban art museums and rural art museums and their effects of availability.

Chapter 3

Literature Review

This literature review examines ways that educators have integrated art within art museums to fit Science, Technology, Engineering, Art, and Mathematics (STEAM) education. This research shares how STEAM engagement has increased in classroom settings, as well as museums within the last ten to fifteen years. According to Riley (2023), "STEAM is an educational approach to learning that uses Science, Technology, Engineering, the Arts, and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking". By creating different ways for problem-solving skills, STEAM activities inspire students to use critical thinking to find solutions. Insights are shared on how STEAM evolved from the original idea of STEM education to include the arts and the subsequent role the art museum can play.

STEM Education Definition

Science, Technology, Engineering, and Math (STEM) education has been used throughout the 21st century to develop critical thinking and learning skills in and out of classrooms and museums. Many definitions are found throughout different educational literature

for STEM education. According to Dell'Erba (2019), STEM education is commonly understood as an approach to learning where science, technology, engineering, and mathematics are applied to real-world problems that connect school and community to promote student achievement and preparation for global competitiveness (p.2). Through analytical thinking, students can use multiple disciplines to look at situations and use these ideas from different disciplines and approaches to come up with an answer. Problems that include math and science can be solved using engineering and technology and vice versa.

Not only has STEM education been used for decades, but the concept of STEM has been around for even longer. Originally the idea gained more recognition in 2011 when the President, Barak Obama, mentioned STEM education in his State of the Union Address to the United States (White, 2014). STEM education was initiated as an educational initiative to use critical thinking and creative problem-solving to give students the ability to be more successful in the workforce (White, 2014). As the importance of technology and the fields feeding into technology started gaining quick popularity, the need for more understanding in the STEM education world began to rise. Marrero et al. (2014), states "STEM understanding and exposure for all students will not only benefit them personally, but will benefit the world, as more engineers, doctors, scientists, and mathematicians grow out of the increased exposure (p.2)". As mentioned before STEM can be defined and described in many ways, but the main goal of STEM education is to develop necessary skills.

STEM to STEAM

Science, Technology, Engineering, Art, and Math (STEAM) education has gained popularity within the past ten to fifteen years. According to Yang and Xu (2021), STEAM education advocates the integration of creative arts knowledge to solve complex problems by

promoting the development of students' higher-order thinking skills and is based on specific situations. Dell'Erba (2019) describes STEAM education to include art and design in STEM to develop a more comprehensive education model. The goal is to attain a well-rounded educational experience using STEAM education. STEAM can also create a way for students to add creative expression through the arts in their problem-solving skills.

Connections made between learning and art help students develop skills for their future. The integration of art into STEM helps teachers ensure students learn directly from the objects, observing how artists discover complex problems and find innovative solutions, as they create their art (Berlin, 2018). Originating as STEM (Science, Technology, Engineering, and Math), the integration of "a" for the arts eventually developed as a valuable component. Ideas of STEAM classes are used through different avenues to inspire critical thinking and problem-solving skills (Riley, 2023). Through learning new experiences and sharing new perspectives, the integration of STEAM education has proven to recognize important factors such as the creativity and artistic expression of students.

Like many learning strategies such as STEM to STEAM, there is always opposition to the ideas proposed and presented. Such arguments made include that there are not enough resources to support the idea of integrating the arts into STEM, "Many of the obstacles that STEAM education faces are due to lack of resources, limited knowledge, and just not enough time or training" (Douglas, 2023). According to Mejias et al. (2021), STEAM is emphasized as an extension of STEM fields for driving economic and national competitiveness. Another obstruction to using STEAM education is the lack of a defined term to describe and use the learning strategy. Not only are there obstructions but the idea of adding the arts to the STEM is not as important to some. According to May (2015), there is a concern that adding the arts into

STEM could dilute the national effort that has been placed on science and technology. STEM focuses on preparing young professionals with certain skills that are necessary to compete in the ever-changing job industry.

Art Museum Education Programs with STEAM

Museum education programs collaborating with schools' help develop learning opportunities for students. By developing a curriculum to meet the needs of students, these programs can also have meaningful connections for the participants. Ideas of programs are shared throughout scholarly literature and articles that include their effectiveness with STEAM education. Susan Dorsey, an education coordinator for school programs at the Walters Art Museum in Baltimore has worked on developing STEAM initiatives (Dorsey, 2023). Collaborations and an increase in STEAM access have been shown through the development of such initiatives for high school students through their collections at the Walters Art Museum. Such ideas include observational drawing lessons, interpretation lessons, data and discovery in art lessons, and scientific illustration and inquiry lessons (Dorsey, 2023).

Art museums have a unique opportunity to include STEAM education. Using dedicated spaces to generate ideas, observe artwork, or even create allows observers to become more immersed in the museum. Art museums have been utilized as learning environments for many years. By integrating the art museum's educational program with STEAM lessons, students will benefit in multiple ways. According to Dorsey (2023), students having increased access to STEAM education opportunities have the potential to benefit the world. Such ideas can encourage students to come up with improved solutions to global challenges. The benefits of such integration would include real-world connections and applications. Museums such as multiple children's museums and science museums have already dedicated programs featuring

STEAM or STEM educational opportunities. These museums include activities such as art labs, STEAM labs, hands-on workshops, open-ended exploration, special events, and at-home activities (Boston Children's Museum, 2023). Boston Children's Museum has a STEAM program that helps to engage children in excitement and discovery through spaces dedicated to different tools, skills, and explorations that are all centered around STEAM. The use of art labs to ignite their imagination helps develop a space focused on visual arts for art making, observing, exploring, expressing ideas, and using different tools (Higgins, 2023). Using problem-solving skills and engagement in these activities help with open-ended explorations, "STEAM education in museums is also more contextual and experiential (Zhang and Hu, 2022, p. 2)". Art museums have the unique opportunity to create spaces that incorporate STEAM through museum displays, collections, and spaces.

An example of a partnership between school and museum education program that incorporates STEAM lessons comes from Georgia. The Union Point STEAM Academy is one of the first rural schools to integrate art and design into all the subject areas in both art classes and regular classroom settings (Mote et al, 2014). Allowing students to find this natural progression of integrating all subjects in a meaningful manner. This school partners with an art museum to apply learning experiences. These learning experiences help to bridge the gap between achievement and participation by using applied learning experiences. By setting goals this partnership can be developed for problem-solving, creativity, and innovative thinking with students. Mote (2014) also notes that with this partnership students can create applied learning experiences, and it shows a way that integrates the art museum into STEM so that STEAM is used throughout the school culture.

The Dallas Museum of Art Uncrated has created a drop-in program for ages 13 to 19 called the Maker Club. The guiding question asks, “What happens when art, science, and technology mix”? Through the incorporation of STEM education, the Maker Club explores a different theme each month and combines open studio and led workshops. Don Undeen, the manager of the Metropolitan Museum of Art MediaLab states, “All artists are, in fact, makers, and museums have the potential to be a living forum where the two groups can talk and inform one another” (Bigornia, 2014, p.2). These examples are art museums that include STEAM. Further in the analysis, there will be more forms of including STEAM within the art museum as well as collaborative work with schools or state standards.

Challenges and Opportunities

Challenges will arise through creating STEAM programs within art museums and creating collaboration with art classrooms. Partnerships in rural settings require more effort than in a typical diverse urban location. In a rural setting, you will have challenges from lack of funding and availability, whereas urban area art museums are more likely to have donors, programs that are funded, adequate staff, and so on. Therefore, the urban area art museums are more readily accessible to students throughout the year whereas a rural setting art museum may only be able to incorporate a STEAM educational program for a small timeframe. According to Mote et al (2014), while some partnerships with museums may send an expert to speak with students about their field, this type of outreach does not translate into deep, meaningful academic impacts. Students are more interested in learning if they can do things hands-on, or if they can connect the ideas to their daily lives and see how they can use them to their advantage. However, it does share opportunities for students to relate and react to a different way of connecting art and real-world experiences. Opportunities that art museums create while using STEAM education

range from hands-on workshops, artist residencies, educational programs, STEAM-focused or STEAM lead tours, spaces dedicated to making or creating, community connections and outreach, as well as collaboration.

Reflections

This literature review first shares an examination of what STEM education is, why it is important for the addition of the "A" to include the arts within STEAM and a brief example of how some art museums use STEAM throughout their education programs. Within the challenges and opportunities, I see the need for more opportunities such as the examples listed. Having challenges such as budget can be attained by fundraising. The lack of knowledge can be gained by classes offered online, or other museums that offer such STEAM-related programs through a field study. Challenges that arise, such as availability, may come up for more rural areas, however, the use of online programs such as Google Arts and Culture page could be used to create a STEAM program right in the classroom that incorporates art museums through a virtual experience. Further in the discussion and analysis, I will discuss the ways that art museums use state standards and align their STEAM program to help fill the gaps that a normal classroom setting needs.

Chapter 4

Discussion

As an art educator, it is important to find ways for students to connect with art outside of the normal art classroom setting. Through a document analysis (Fig 4.1-Fig 4.6) of scholarly articles and online resources I have been able to understand and appreciate how STEAM is included in education as well as within art museums. I have also been able to find ways that art museums have used STEAM education programs (Fig 4.7- Fig 4.8) and ways that they could be

improved upon. One main idea for improvement would be a stronger collaboration with schools. I interviewed the high school art teacher within my school district, as well as a museum board member at a local art museum, the Robert Henri Museum in Cozad, Nebraska. I used a few conversation starters guided by the case study questions to perform an informal interview. Through the interviews, I collected data and analyzed their reflections, and finally, I reflected upon the positives and best practices that would be recommended to museums for the implementation of STEAM programs to enhance student learning. Through document analysis, interviews, and reflection I can find ways that students, educators, and museums can benefit from the inclusion of STEAM education.

Results From Document Analysis

I began my examination into the opportunities to which art museums present students through STEAM-guided classes. Figure 4.1 and Figure 4.2 show hands-on learning from an elementary school collaborating with a museum next door in New York City (Rolling Jr, 2016). Through an Integrated Project Week, students were able to use STEAM-inspired learning to create their topographic maps. Students researched, planned, measured, and designed their maps that are shown in the figures below. Using STEAM, the students were able to learn through science, technology, and engineering on how and why topographic maps were used. Then using mathematic skills and art skills they created individual maps with art supplies. Steps from the STEAM project are shared below from the museum's use of educational opportunities for the students.

Figure 4.1

Steps from STEAM projects

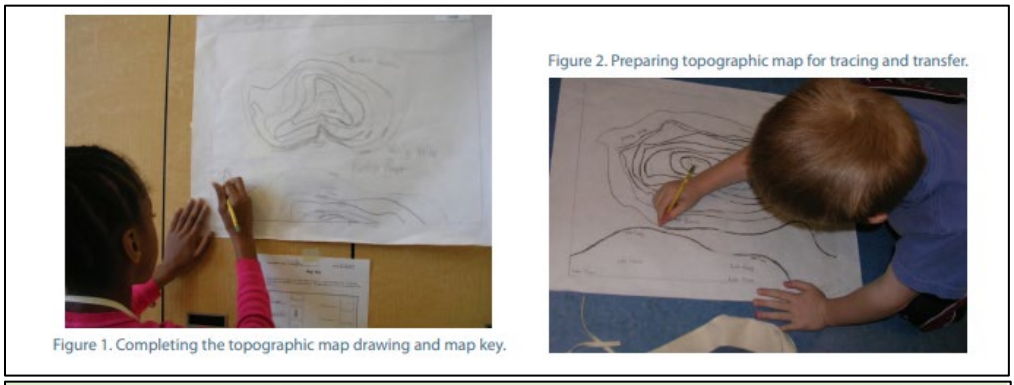


Figure 1. Completing the topographic map drawing and map key.

Figure 2. Preparing topographic map for tracing and transfer.

Figures 3–5. Painting the imagined three-dimensional world.

Figure 4.2

Finished Projects from STEAM inspired lesson with literature explanation.

Figure 8. An earthly landscape.

Figure 9. An alien landscape.

"Hands-On Land Forms" was conceived as a Fall 2004 Integrated Project Week (IPW) offering for 3rd- and 4th-grade students. An IPW was intended to involve small groups of students from different classes and grade levels in a focused and extended collaborative learning exercise that would allow each student to deepen their understanding of a particular topic, theme, or concept already encountered in the curriculum, and in which they had indicated an abiding interest. These project outcomes were then exhibited and/or performed in a culminating school-wide showcase to which all families were invited.

Our Hands-On Land Forms project prompted students to invent hand-drawn imaginary maps of landforms on the earth's surface they had recently learned about in science class (e.g., bay; peninsula; mesa, volcano; desert, canyon). This STEAM engine for learning immediately engaged students, rapidly gathering momentum as they translated the contour lines of their topographic maps into three-dimensional terrains utilizing Foamcore and corrugated cardboard, safety blades, Elmer's glue, papier mâché, architectural scale rulers, and other supplies as needed. Drawing on my own background as an architecture student and a freelance architectural model maker, I was able to facilitate the construction of anything a student wished to build. We traveled with students through the stations of inventing a topographic terrain map, drawn to scale (Figure 1); tracing each elevation layer onto Foamcore and cutting it out (Figure 2); stacking and gluing the layers together in order of descending elevation and smoothing out the transitions with papier mâché (Figure 3); painting the imagined three-dimensional world (Figures 4, 5, 6); and creating a painting of the imagined landscape as if we were standing in it (Figure 7). In the process, students created models of landscapes that varied from the earthly to the alien (Figures 8, 9).

As noted, in the literature review, I compare more scholarly articles that include STEAM within art museums, the results from the document analysis show the following art museums using STEAM classes to enhance their educational programs. Interactions between art museums and schools are found through learning goals that are connected to state standards. One example of this is found at the McNay Art Museum in San Antonio, Texas. The McNay Art Museum presents guides for students that include key questions focused on students in the secondary levels. The Texas state standards known as the Texas Essential Knowledge and Skills (TEKS) shown in Figure 4.3 are aligned with the museums' student learning goals for their STEAM classes. For grades 6-12, students are given key questions (Fig 4.4) for STEAM exploration and a list of artworks to consider throughout the museum (Appendix A).

Figure 4.3

The McNay Art Museum's Student Learning Goals and Texas State Standards (TEKS) aligned with the project:

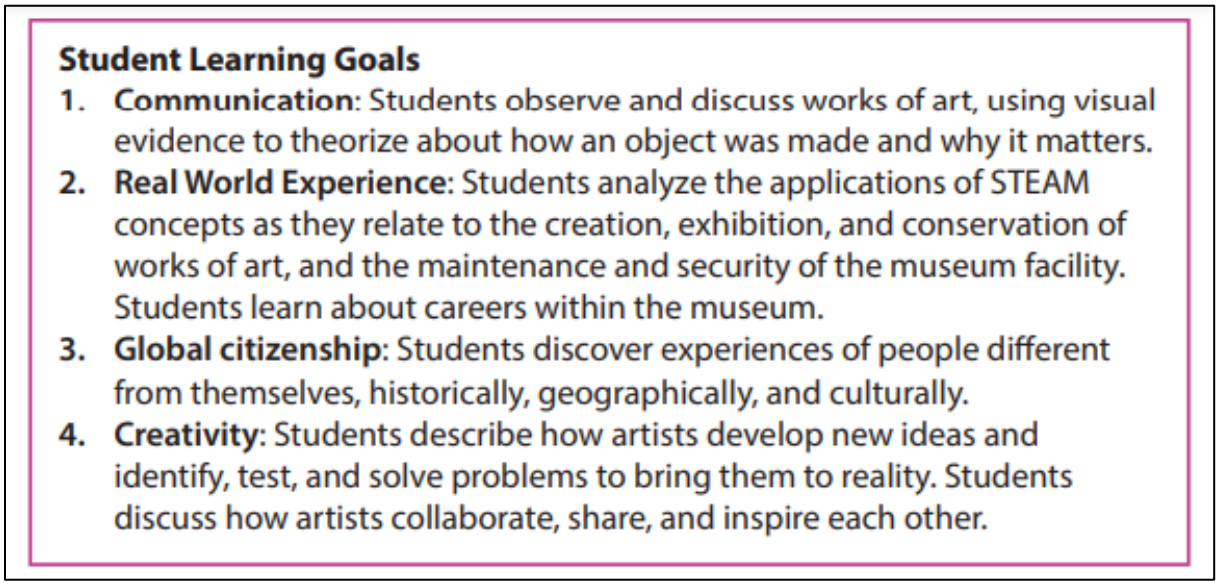


Fig 4.3 Continued

Connections to Texas Essential Knowledge and Skills (TEKS)

Middle School

1. Investigate and explore original artwork outside the classroom in museums. (Art 4C)
2. Relate the impact of research on scientific thought and society. (Sci 3D)
3. Explain how changes in technology throughout history have impacted various areas of study. (Tech App 6H)

High School

1. Identify and understand the elements and principles of art including line, shape, color, texture, form, space and value as well as emphasis, repetition/ pattern, movement/rhythm, contrast/variety, balance, proportion, and unity. (Art 1 B, C)
2. Evaluate the impact of research on scientific thought, society, and the environment. (IPC 3 C)
3. Develop an understanding of elements, principles of art and evaluate works of art. (Prin. Art/AV/Comm. 11B, D)
4. Describe how technology affects individuals, societies, cultures, economies and environments and influenced past events. (Con. of Engn. & Tech 4A, B)
5. Analyze digital art designs. (Dig. Art & Anim. 1F)
6. Research the history of 3-D modeling and animation. (3-D Mod. & Anim. 3B)

Figure 4.4

Key Questions for STEAM exploration

1. How was this work of art made?
2. How is it cared for?
3. What could it mean?
4. What are you curious about?

Another museum that offers STEAM classes that are connected and adapted to state standards comes from the High Museum of Art in Atlanta, Georgia. The High Museum of Art has an extensive STEAM program that provides workshops, tours, teacher resources, and professional development seminars that support a well-rounded education (Berlin, 2023). The museum's collections of art are used for evidence of creative problem-solving (Appendix B). With the use of the museum's art collection students find evidence of creative problem solving.

Berlin (2023) noted that students can learn directly from objects, observe how artists discover complex problems, and find innovative solutions. Through these findings students can create their own art. This provides the students with an environment ideal for experimentation, as well as developing the student's curiosity and flexibility. Like the McNay Art Museum, the High Museum of Art offers essential questions for students to guide them through the museum in an informal tour. The High Museum of Art presents STEAM projects suitable for different age groups. The age groups that they focus on are Kindergarten through fifth grade, third grade through fifth grade, and fifth grade through eighth grade. These essential questions are also aligned to the Georgia state education standards shown in figure 4.5 and appendix B. Aligning the standards to these essential questions guides the students through the museum on a tour to develop responsive skills through the study and production of art. The High Museum of Art became the first museum in the country to create a STEAM program in 2013 and has adapted learning since (Figure 4.6). Programs such as those listed have proved successful while including STEAM through museums and within schools. By using the state standards, students and educators can connect the needs of students to the projects within the STEAM education programs. The success of these programs is shown through the longevity of the courses offered. Each museum has been able to continue these types of programs for multiple years, proving success in attendance, interest, and products created.

Figure 4.5

Example of Essential Questions guiding Tour/Workshop

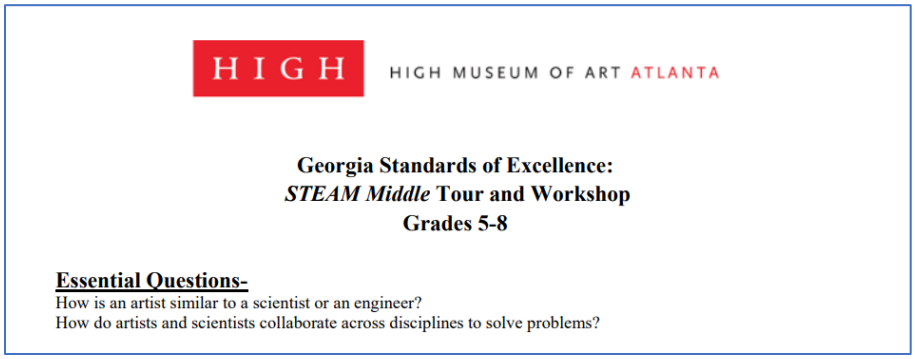
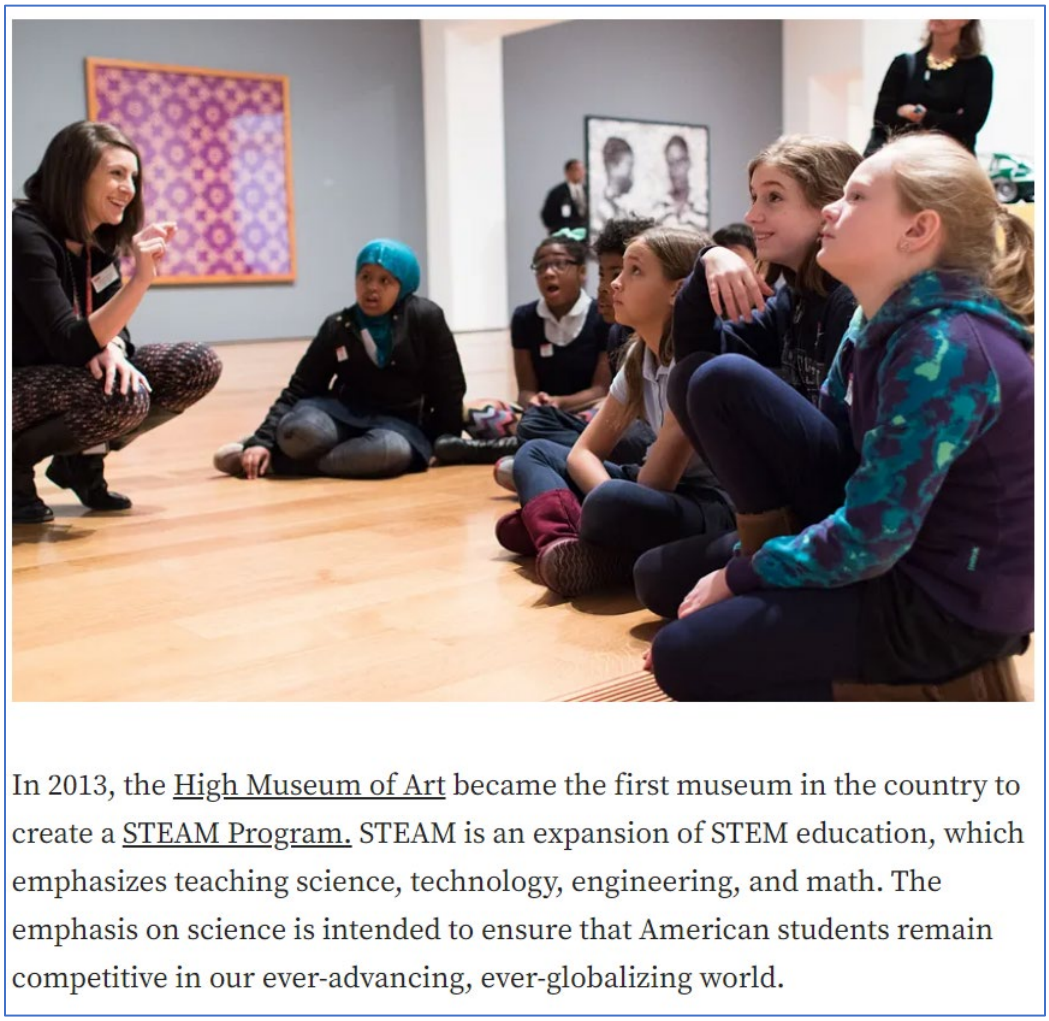


Figure 4.6

The High Museum of Art – Atlanta collaboration



Art Museums using STEAM without collaborations with schools:

The Briscoe Western Art Museum located in San Antonio, Texas offers a "Full STEAM Ahead" program that includes hands-on learning. Activities are offered monthly to engage student learners with STEAM education. Noted by the Briscoe Western Art Museum, "each of the activities ties back to Briscoe's art and artifacts, bringing the West to life in a new way. From transportation and weather to animals, astronomy, and engineering, each program explores an aspect of life in the West to engage and inspire learning" (2023). Through these programs, the students can explore artifacts and art to make personal connections (Fig 4.7). One example of their monthly program is the Native American Homes – STEAM engineering challenge. Students can engage in the art display of native American homes through created artwork, and then use different materials to try to build a Native American shelter.

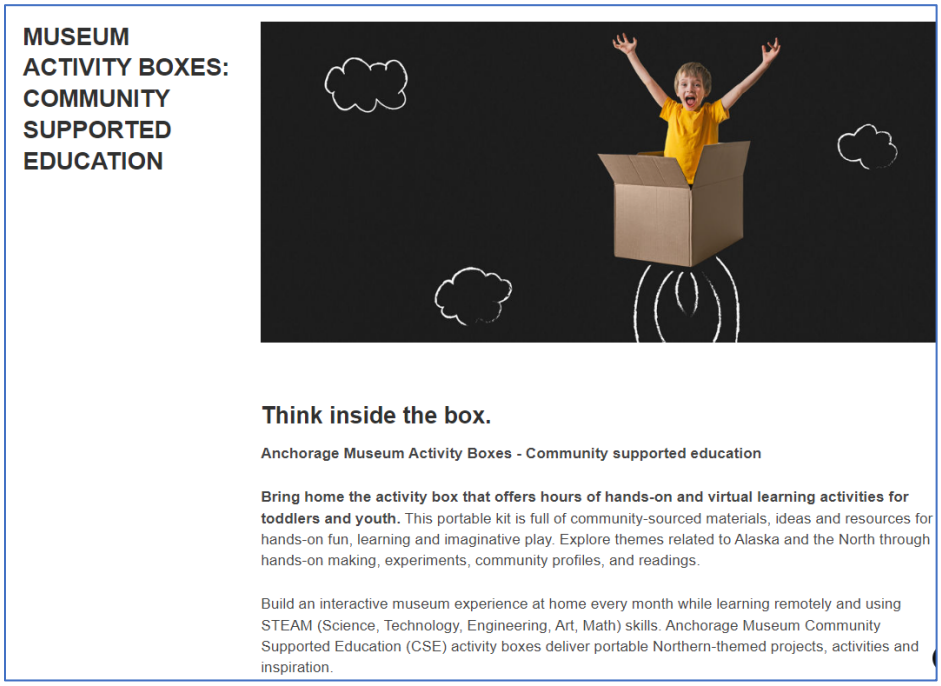
Figure 4.7

Briscoe Western Art Museum, full STEAM ahead program layout:

Another art museum that offers a STEAM type of program is the Anchorage Art Museum in Anchorage, Alaska. The type of program that they offer through STEAM inspiration is a "think inside the box" where they create portable kits for students to take home (Anchorage Museum, 2023). The activity boxes are built with STEAM educational goals in mind and create an interactive museum experience remotely (Fig.4.8). These STEAM-driven educational boxes include community-sourced materials and have themes that are related to Alaska, bringing in the connection of the importance of artwork within the community and state. Without state standards connected, this type of program is more open-ended. Included in the take home box are suggested guidelines and ideas for how to use the art box with STEAM connections. Community-supported education is another way to tie STEAM education programs into art museums. The Anchorage Museum offers an area for creation and fostering knowledge and discovery; however, they do not label it as a STEAM lab within the art museum. They use the space for field trips and connect the artwork that the students view with projects that they create within the lab. Success is measured through these types of programs on consistency and availability. The Briscoe Western Art Museum and The Anchorage Art Museum can sustain their STEAM programs by keeping such ideas and opportunities available for students to access. Their consistency of monthly activity boxes and STEAM-inspired monthly projects show the community the importance of continuation and connection with students and art museums.

Figure 4.8

Museum Activity Box information



Findings From Interviews:

As this case study examines the connection with STEAM education with art museums, it also looks at the collaboration with schools. The interview process that was conducted for this study was informal but informative. The questions that led the conversation were based on the research questions for this case study:

1. How can museums impact student learning through educational STEAM programs?
2. How can learning be structured through the STEAM curriculum to be supported by art museums?

I interviewed two individuals that represented the school and the local art museum. Ideas were presented to a co-worker at the high school level, Trey Botts and a board member of the Robert Henri Museum, Charles Birgen and their responses are recorded below.

Trey Botts Interview Findings:

Cozad High School art teacher, Trey Botts, has worked in the Cozad Community School system for ten years. Through conversations at school as well as email interview questions, the responses from Botts were collected and summarized.

> **Summary of Botts' responses:** Botts stated that STEAM programs offered through an art museum would be a great resource for kids. Through implementation, these programs can impact student learning by helping them make connections between art and other disciplines. Having access to such a program is a large area of importance, by giving students access to STEAM programs within an art museum setting, students will benefit in the long run. Important connections that they can find through these educational practices will drive their curiosity and hopefully their continuation of attending other art museums that offer STEAM education lessons or workshops. Botts continued on the idea of opportunities and the ways that a strong collaboration between art museums and schools can create positive outcomes. When talking about the structure of which STEAM curriculum could be supported, Botts had multiple ideas that led the conversation. "First and foremost, being an art museum, I would think that all curriculum in STEAM should start with the art, then branch out to other disciplines". Botts felt that having a goal to use as a gateway to learn about other subjects will help the students view art differently. With STEAM programs within an art museum, students can view art in a non-threatening way.

Author's notes: While talking about an art museum impacting student learning, Botts made a great contribution to the interview, his belief in the importance of access. Through connections, many opportunities should arise, such as a lead to job opportunities, further interest in helping with projects or lessons, and discovering new ways to incorporate into schools. A continuation of results and connections were discussed about curriculum and how it would be structured to support students. A common idea of a focused goal was of importance during that discussion. The open-minded idea of working through art in a new way will help students realize that there is some overlap between art and everything else.

Charles F. Birgen Interview Findings:

The Robert Henri Museum has an acting board that serves the community and the museum through volunteer time. Charles F. Birgen has served the Robert Henri Museum since 2017 as a board member, treasurer, and Docent. The same questions were asked in an informal interview with Mr. Birgen about STEAM education programs within art museums.

Summary of Birgen's responses: Birgen started off our conversation with the thought that typically one wouldn't think of an art museum as a place to include STEAM lessons that are hands-on. He continued to note the uniqueness of the art museum aspect within such an idea could greatly impact the students in a positive way. Any outreach program to students would be impactful, such as opportunities to study the gallery work of Robert Henri's portraits. Lessons of portraiture, color palette and theory, or even perspective and proportion could all stem from such opportunities within the art museum. Birgen notes that the museum offers a variety of technologies used throughout to guide tours to guests, he mentioned ideas of using such technologies to work with a STEAM inspired class as

well. While discussing curriculum Birgen stated “having the opportunity to this type of STEAM program would definitely benefit the students, but adding more to a very full curriculum might be a challenge for teachers”. If there was a certain time or way to bring students to the art museum to tie into already planned curriculum, such as perspective drawing, design mock-ups for shows, portrait drawing that it would benefit all involved. Birgen also remarked that the summer months are when the Robert Henri Museum and Gallery acquire most of their visitors. Around 75 percent of its visitors come from interstate traffic, but while the museum is closed during the winter months – the board would be more than interested in helping in any way to get a program started that would assist visitors from the middle school program. Birgen noted that it would be possible to do such a program or have these opportunities through no to low-cost educational programs.

Author’s notes: Birgen and I both agreed that the idea of having this connection between the school and the art museum could be very successful in our community. Many ideas and project ideas came from this conversation. Within our conversation we both mentioned that classes within the museum for educational purposes are unique to the Robert Henri Museum, as it is the home of the artist drawing the deep history of Cozad into the educational experience as well. We find challenges through our conversation that are similar to other rural art museum challenges, with funds and program participants. Starting small on an educational goal such as a program dedicated to STEAM seemed like a great outreach and opportunity.

Reflections from Interview with Trey Botts and Charles Birgen:

The similarities of these interviews were analyzed from the summaries. General ideas and considerations were both in favor of creating access for students to explore STEAM through an art museum would be beneficial to students. As mentioned by Birgen, everyone learns in different ways. The museum creates a space for students and visitors to learn by their own ability. The use of visual text, audio guided tours, private tours, group tours, technology used to describe museum aspects and paintings are all available. These resources could be used in a STEAM-inspired activity within the art museum. Through collaboration with schools, setting goals in a positive and attainable manner could grow with different capabilities.

In comparison to the literature, both conversations lead to the inevitable discussion of funds and availability. However, there are ways to acquire these funds through grants, fundraising, volunteer time, and so on. Similarities between interviews also landed on access, when are the students going to do this type of program: during school hours, after school program or a workshop like a conference could be used. Differences in the idea lie in the aspects of how to create such a program to fit into an already full curriculum.

While thinking about the responses from Botts and Birgen, I began to develop my thoughts on the questions and how my thoughts compared to theirs. As I research and conclude successes from these programs I agree with certain aspects of both interviews. I like the point that Botts brings up about access. With a new addition to the local museum being built, more opportunities are going to be available for students. The aspect that our local museum, the Robert Henri Museum, uses the childhood home of the artist as its museum it shares a part of history with the students. I also agree with Birgen's ideas of design work used as a connection between school and art museum. Previous UNK students have worked, learned, and created designs for

the interior of the museum and gallery shows, and they are now working on the new gallery building with designs in mind from interior design students.

Learning through the STEAM curriculum can adapt to ideas from this museum by looking at the science behind keeping artwork in a climate-controlled gallery, the restoration of paintings, and the technology that goes into the storytelling aspect of the gallery through guided tours of information. The museum also offers an artist of the month during the summer months which can also be included within a STEAM curriculum. These ideas can all support students and their learning through educational STEAM programs in art museums.

Observations

After analyzing documents related to STEAM educational programs within art museums, the research shares that there are no right or wrong ways to conduct such practices. By setting a learning goal and collaborating, schools and art museums can offer STEAM educational programs that connect with students. Success is shown strongly through the collaborative efforts of art museums and schools that can tie their state standards to their learning goals. Without a collaborative effort between school and art museums, the art museums miss the opportunities to create connections outside of the art museum. By having a learning goal in mind, working toward that goal together, shows the students the importance of the activities. By having availability and access, students can connect with more than the art in art museums, they can find and determine processes in making the art, the science, technology, engineering, or math behind the artworks.

Activity classes are offered at Cozad Middle School with STEAM-inspired learning. These classes are known as activity classes and include opportunities for students to learn about different areas of their interest. STEAM activity class examples include Science - dissection and

science fair, Technology - coding and introduction to Photoshop, Engineering - robotics and coding, Art – community art projects of barn quilts and watercolor techniques, and Mathematics classes include sports statistics and break-out games. These classes run for a month and are aimed at giving students an engaging experience in one of their areas of interest. By introducing the opportunity to learn at the local art museum, students are able to expand their learning opportunities within the community. Having the art museums stand for the A in STEAM acronym is more attainable through access and collaboration work. These STEAM classes allow students to learn new skills that connect the many different disciplines.

As a reflection and observation, students react to opportunities that are presented to them outside of the typical classroom learning in a different manner. By offering a collaborative experience during STEAM classes, students can initiate more contact with art museums. Through research and knowledge gained through this case study, the use of online resources such as Google Arts and Culture could also be used to introduce museums and connect STEAM lessons for students within the classroom. By having a goal in mind, as well as connections to standards, educators and administrators will see the importance of strong collaborative work between schools and museums through STEAM education classes and art museums.

Chapter 5

Conclusion

Art museum education programs can use ideas from STEAM education to increase the attendance of the younger generation. Art museums can develop programs with students in mind that will strengthen their educational experience in a non-formal educational setting. By representing the A in STEAM, art museums such as the Robert Henri Museum create an educational outlet that provides students with many opportunities. A collaboration between the

school and the art museum proves access for these programs to be developed with middle school students in mind. Ideas of such programs are shared throughout scholarly literature and articles that share ideas of programs and their effectiveness with STEAM education. Connections that students find as learners and observers throughout the art museum prove to be impactful through multiple art museums offering such classes and opportunities. Through a continuation of building the STEAM-inspired activities classes within Cozad Middle School, more emphasis could be added through state standards. With a developing curriculum to meet the needs of students, as noted before these programs can also have meaningful connections for the participants.

Having the Robert Henri Museum willing to work with students gives them a new perspective on using STEAM outside of the classroom and inside of an art museum. Creating a new opportunity for art museums to be seen as the "A" in STEAM. Such collaboration and efforts create real-world connections to meet the needs of students. The development and implementation of STEAM educational programs within art museums creates opportunities that students may not find elsewhere. With time built into the curriculum for such opportunities, teachers and art museum education program coordinators can enhance student learning. These community connections share unique access for students to gain attraction in different areas of interest.

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Appendix

A.

The McNay Art Museum – Works of Art to Consider, list of artwork to connect with TEKS and Learning Goals.

theMcNay
McNay Art Museum

STEAM
Science, Technology, Engineering, Art, Math

Grades 6–12
Apply STEAM concepts in real world situations. Look for and describe evidence of artist experimentation, invention, and imagination.


George Rickey, *Horizontal Column of Five Squares, Excentric II*

Student Learning Goals
1. **Communication**: Students observe and discuss works of art, using visual evidence to theorize about how an object was made and why it matters.
2. **Real World Experience**: Students analyze the applications of STEAM concepts as they relate to the creation, exhibition, and conservation of works of art, and the maintenance and security of the museum facility. Students learn about careers within the museum.
3. **Global citizenship**: Students discover experiences of people different from themselves, historically, geographically, and culturally.
4. **Creativity**: Students describe how artists develop new ideas and identify, test, and solve problems to bring them to reality. Students discuss how artists collaborate, share, and inspire each other.

Connections to Texas Essential Knowledge and Skills (TEKS)

Middle School
1. Investigate and explore original artwork outside the classroom in museums. (Art 4C)
2. Relate the impact of research on scientific thought and society. (Sci 3D)
3. Explain how changes in technology throughout history have impacted various areas of study. (Tech App 6H)

High School
1. Identify and understand the elements and principles of art including line, shape, color, texture, form, space and value as well as emphasis, repetition/pattern, movement/rhythm, contrast/variety, balance, proportion, and unity. (Art 1 B, C)
2. Evaluate the impact of research on scientific thought, society, and the environment. (IPC 3 C)
3. Develop an understanding of elements, principles of art and evaluate works of art. (Prin. Art/AV/Comm. 11B, D)
4. Describe how technology affects individuals, societies, cultures, economies and environments and influenced past events. (Con. of Engn. & Tech 4A, B)
5. Analyze digital art designs. (Dig. Art & Anim. 1F)
6. Research the history of 3-D modeling and animation. (3-D Mod. & Anim. 3B)

Key Questions for STEAM exploration
1. How was this work of art made?
2. How is it cared for?
3. What could it mean?
4. What are you curious about?

Works of Art to Consider
1. Architecture of the McNay
2. Tim Bavington, *She is Love*
3. Erik Benson, *Dead Air*
4. Chakaia Booker, *Position Preferred*
5. Albrecht Bouts, *Moses and the Burning Bush* and *Gideon and the Fleece*
6. Tim Burton, *The Nightmare Before Christmas*
7. Alexander Calder, *Four Winds*
8. Arthur B. Davies, *Listening to the Water Ousel*
9. Leonardo Drew, *Untitled (33A)*
10. El Greco, *Head of Christ*
11. Carl Rice Embrey, *Confederate Jasmine*
12. Paul Gauguin, *Portrait of the Artist with the Idol*
13. George Grosz, *The Gymnast*
14. Robert Indiana, *LOVE*
15. Luis Jimenez, *Man on Fire*
16. Alexander Liberman, *Ascent*
17. Ken Little, *Dawn*
18. Oppenheimer 3 Stop
19. Camille Pissarro, *Haymakers Resting*
20. George Rickey, *Horizontal Column of Five Squares, Excentric II*
21. Kate Ritson, *In Balance*
22. Joel Shapiro, *Untitled* (Blue Man)
23. David Smith, *Stainless Network I*
24. Tony Smith, *Asteriskos*
25. *St. George*

Vocabulary

acrylic paint	kinetic sculpture
art conservation	light sensitive
bronze	oil paint
climate control	optical mixing
found objects	patina
infrared light	stop motion
installation	tempera
	weathering

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B.

High Museum of Art – Atlanta, GA. Standards and Tour Workshop Questions

HIGH MUSEUM OF ART ATLANTA

Georgia Standards of Excellence:
***STEAM Middle* Tour and Workshop**
Grades 5-8

Essential Questions-

How is an artist similar to a scientist or an engineer?
How do artists and scientists collaborate across disciplines to solve problems?

Grade 5

Math

MGSE5.NF.5	Interpret multiplication as scaling (resizing).
MGSE5.MD.1	Convert among different-sized standard measurement units (mass, weight, length, time, etc.) within a given measurement system (customary and metric) (e.g., convert 5cm to 0.05m), and use these conversions in solving multi-step, real world problems.
MGSE5.G.3	Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category.
MGSE5.G.4	Classify two-dimensional figures in a hierarchy based on properties (polygons, triangles, and quadrilaterals).

Science

S5E1.	Obtain, evaluate, and communicate information to identify surface features on the Earth caused by constructive and/or destructive processes.
S5P1.	Obtain, evaluate, and communicate information to explain the differences between a physical change and a chemical change.

Art

VA5.CR.1	Engage in the creative process to generate and visualize ideas by using subject matter and symbols to communicate meaning.
VA5.CR.2	Create works of art based on selected themes.
VA5.CR.3	Understand and apply media, techniques, processes, and concepts of two-dimensional art.
VA5.RE.1	Use a variety of approaches for art criticism and to critique personal works of art and the artwork of others to enhance visual literacy.
VA5CN.1	Investigate and discover the personal relationships of artists to community, culture, and the world through making and studying art.
VA5.CN.2	Integrate information from other disciplines to enhance the understanding and production of works of art.
VA5.CN.3	Develop life skills through the study and production of art (e.g. collaboration, creativity, critical thinking, communication).

Grade 6

Math

MGSE6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

MGSE6.NS.3	Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
MGSE6.EE.1	Write and evaluate numerical expressions involving whole-number exponents.

MGSE6.G.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.
MGSE6.SP.1	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.

Science

S6E1.	Obtain, evaluate, and communicate information about current scientific views of the universe and how those views evolved
S6E6.	Obtain, evaluate, and communicate information about the uses and conservation of various natural resources and how they impact the Earth.

Art

VA6.CR.1	Visualize and generate ideas for creating works of art.
VA6.CR.2	Choose from a range of materials and/or methods of traditional and contemporary artistic practices to plan and create works of art.
VA6.RE.1	Reflect on the context of personal works of art in relation to community, culture, and the world.
VA6.RE.2	Critique personal works of art and the artwork of others, individually and collaboratively, using a variety of approaches.
VA6.RE.3	Engage in the process of art criticism to make meaning and increase visual literacy.
VA6.CN.1	Develop personal artistic voice through connecting uses of art within a variety of cultural, historical, and contemporary contexts.
VA6.CN.2	Develop life skills through the study and production of art.
VA6.CN.3	Utilize a variety of resources to understand how artistic learning extends beyond the walls of the classroom.

Grade 7

Math

MGSE7.RP.2	Recognize and represent proportional relationships between quantities.
MGSE7.NS.3	Solve real-world and mathematical problems involving the four operations with rational numbers.
MGSE7.G.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.
MGSE7.G.2	Explore various geometric shapes with given conditions. Focus on creating triangles from three measures of angles and/or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

Science

S7L1.	Obtain, evaluate, and communicate information to investigate the diversity of living organisms and how they can be compared scientifically.
S7L4.	Obtain, evaluate, and communicate information to examine the interdependence of organisms with one another and their environments.

Art

VA7.CR.1	Visualize and generate ideas for creating works of art.
VA7.CR.2	Choose from a range of materials and/or methods of traditional and contemporary artistic practices to plan and create works of art.
VA7.RE.1	Reflect on the context of personal works of art in relation to community, culture, and the world.
VA7.RE.2	Critique personal works of art and the artwork of others, individually and collaboratively, using a variety of approaches.
VA7.RE.3	Engage in the process of art criticism to make meaning and increase visual literacy.
VA7.CN.1	Develop personal artistic voice through connecting uses of art within a variety of cultural, historical, and contemporary contexts.
VA7.CN.2	Develop life skills through the study and production of art.
VA7.CN.3	Utilize a variety of resources to understand how artistic learning extends beyond the walls of the classroom.

Grade 8

Math

MGSE8.G.1	Verify experimentally the congruence properties of rotations, reflections, and translations: lines are taken to lines and line segments to line segments of the same length; angles are taken to angles of the same measure; parallel lines are taken to parallel lines.
MGSE8.G.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.
MGSE8.G.3	Describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates.
MGSE8.G.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.

Science

S8P1.	Obtain, evaluate, and communicate information about the structure and properties of matter.
S8P3.	Obtain, evaluate, and communicate information about cause and effect relationships between force, mass, and the motion of objects.

Art

VA8.CR.1	Visualize and generate ideas for creating works of art.
VA8.CR.2	Choose from a range of materials and/or methods of traditional and contemporary artistic practices to plan and create works of art.
VA8.RE.1	Reflect on the context of personal works of art in relation to community, culture, and the world.
VA8.RE.2	Critique personal works of art and the artwork of others, individually and collaboratively, using a variety of approaches.
VA8.RE.3	Engage in the process of art criticism to make meaning and increase visual literacy.
VA8.CN.1	Develop personal artistic voice through connecting uses of art within a variety of cultural, historical, and contemporary contexts.
VA8.CN.2	Develop life skills through the study and production of art.
VA8.CN.3:	Utilize a variety of resources to understand how artistic learning extends beyond the walls of the classroom.