



## A STEAM Activity to Design a Virtual Rectangular Prism Museum for 5th Graders

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### Abstract

This study proposes a STEAM activity for teaching rectangular prisms to 5th-grade students, aiming to integrate science, technology, engineering, art, and mathematics. The activity is designed for four class hours, following the 5E instructional model. In the engagement phase, it was aimed to attract students' interest in the museums. In the exploration phase, students will be asked to research rectangular prisms and rectangular prisms that exist in nature and are used in architecture, and the research phase, they will be asked to create draft drawings and concrete 3D models on the computer about rectangular prisms. In the explanation phase, the teacher explains the fundamental elements of a rectangular prism, the drawing of surface area configurations, and information about whether different configurations belong to a rectangular prism in accordance with the Grade 5 learning outcomes. In the elaborating phase, students design a virtual museum of rectangular prisms and acquire achievements from the fields of science, technology, engineering, art, and mathematics. During the evaluation phase, the prepared museums will be rated via a rubric form. The proposed activity has not been implemented yet and leaving room for future studies to explore its impact on students.

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## Introduction

In the 19th and 20th centuries, characterized by industrialization, individuals were expected to engage in trade, adhere to systematic rules, demonstrate fairness and honesty, and think professionally within a relatively static system (Hamarat, 2019). However, towards the end of the 20th century, as the world entered an era encompassing knowledge, technology, and globalization, it became evident that the skills individuals possessed fell short of meeting the expectations of the new century. With the advent of the digital age, creativity, and problem-solving skills have become highly valued, and individuals are now expected to excel as part of a team (Larson & Miller, 2011).

In the 21st century, the use of information and technology has become increasingly crucial. To access quality information and effectively utilize technology for personal development and growth, individuals need to possess certain skills. 21st-century skills refer to the abilities that enable individuals to be self-sufficient and more competitive in the world of technology (O'Neal et al., 2017). These skills generally encompass collaboration, communication, digital literacy, problem-solving, critical thinking, creativity, and productivity (Hebebcı & Usta, 2022; Voogt & Roblin, 2012). The 21st century is characterized by rapidly evolving technological and scientific advancements. These developments have brought about a shift in the skills needed by societies and the business world. In response to these changing needs, the STEAM (STEM+ART) education approach has emerged as a highly relevant and effective method. The STEAM (Science, Technology, Engineering, Art, and Mathematics) approach combines the disciplines of science, technology, engineering, and mathematics (STEM) with the arts, providing a comprehensive and interdisciplinary framework that fosters critical thinking, inquiry, and dialogue (Cook, 2012; Belardo, 2015; Turner, 2017; Hebebcı, 2021; 2023). STEAM is used as a tool/method that can make significant contributions to the development of students' cognitive, affective, and psychomotor skills (Topuz et al., 2019). According to Türk and Korkmaz (2023), STEM activities improve students' problem-solving abilities and success levels in mathematics courses.

STEAM is an interdisciplinary approach that encompasses the fields of science, technology, engineering, art, and mathematics. It is regarded as a significant instructional technique in modern education, emphasizing experiential learning and fostering connections between industry, academia, and society (Tsupros et al., 2009). The need for individuals who are well-equipped, capable of working collaboratively, and proficient in utilizing technological tools has increased in response to evolving technologies, changing needs, and new requirements. STEAM provides students with opportunities to engage in project-based, collaborative work and experiential learning, enabling them to gain tangible experiences and make sense of the world around them. Students who receive STEAM education can apply their knowledge gained from the fields of science and mathematics to

create solutions for real-world problems, utilizing engineering principles and technology (Kennedy & Odell, 2014). One of the most popular technological educational tools recently is virtual museums.

A Virtual Museum is defined as a museum that hosts digital objects and their information prepared by utilizing different media possibilities, in uninterrupted communication with the visitor, going beyond the usual communication methods to meet various forms of access, and not requiring a physical space to enable worldwide access (Schweibenz, 2004). Düzgün (2007), on the other hand, explained it as museums that host digital objects and their information prepared by utilizing different media opportunities, in uninterrupted communication with the visitor, going beyond the usual communication methods to meet various forms of access, and not requiring a physical space in order to enable worldwide access. The most functional feature of the virtual museum is that it provides an easily accessible virtual circulation by digitizing the museum collection and presenting it to the museum audience online (Çolak, 2006). It makes art and culture livable for those who cannot spare time to visit museums or live in geographically distant regions (Teather, 1998 as cited in Barlas Bozkuş, 2014) and provides visitors with the opportunity for simultaneous discovery, interaction and participation (Salar, 2009). Thus, it saves visitors from being passive and encourages them to be active sharers and participants in a democratic environment (Karadeniz et al., 2015).

In conclusion, virtual museums can be incorporated into educational programs as conveniently accessible learning settings thanks to their extensive and rich collections. However, the interaction between the student and the learning environment is essential for the effective use of virtual museums as a teaching tool. The teachers, who are meant to direct the learning process, are anticipated to play the main role in this interaction (Arabacioglu & Okulu, 2021). Lesson plans can serve as models for lessons and show a teacher's pedagogical style, method of teaching, or technical expertise for the benefit of a learning community's professional growth (Morales et al., 2020). According to Namdar and Kucuk (2018), tests on lesson plans can give prospective teachers experience in a variety of areas, including developing science-based questions for an inquiry-based course, alternative assessment and evaluations, and data gathering and analysis. The fact that the STEAM approach is new in Türkiye and that resources on sample lesson plans and activities are more limited is seen as a need in the literature (Kızılay, 2021). It is believed that the inclusion of a sample activity for this need in the study will be beneficial for teachers and the literature.

### **Aim of the Research**

This study aims to propose an activity for 5th-grade students, aligned with the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach and based on the 5E instructional model. The proposed activity focuses on designing a virtual museum of rectangular prisms. Through this activity, students will have the

opportunity to acquire knowledge and skills in the fields of Science, Technology, Engineering, Arts, and Mathematics (STEAM).

## Method

This research includes an activity proposal that deals in detail with the process of preparing a virtual museum about rectangular prisms. According to Bybee (2009), activity based school programs that include instructional models have the potential to develop 21st century skills. This research includes an activity proposal designed according to the 5E Model that deals in detail with the process of preparing a virtual museum about rectangular prisms.

### Designing the Lesson Plan

The 5E instructional model enables learning a new concept or trying to understand a concept in depth. It includes skills and activities that stimulate students' research curiosity, satisfy their expectations, and focus them on an active search for knowledge and understanding. It is suitable for students of all ages, including adults. Each of the 5E phases begins with the letter "E" and represents a distinct stage of the learning process: Engage, Explore, Explain, Elaborate, and Evaluate (Eisenkraft, 2003). The phases of the 5E Model are presented with details in Figure 1.

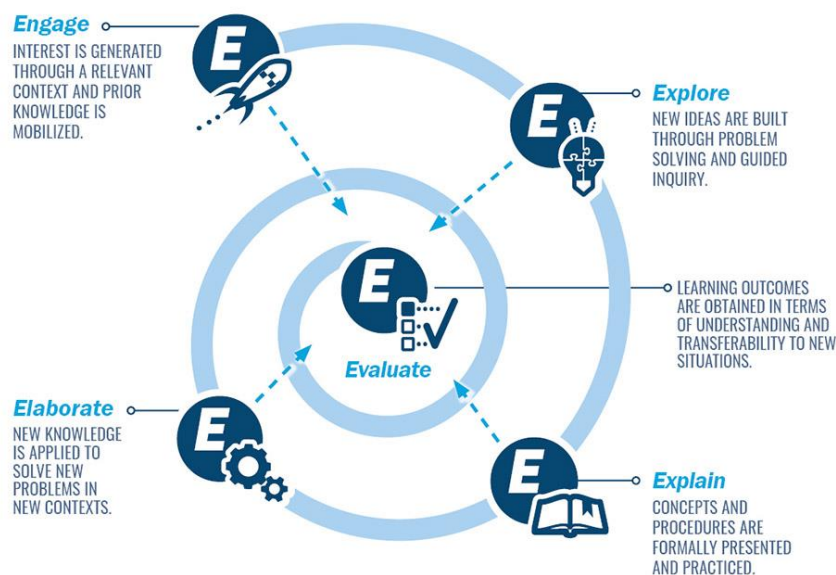


Figure 1. The 5E Model (International Science Teaching Foundation, 2022)

The learning outcomes for different disciplines, the activity plan, and the rubric form to be used as an assessment tool were selected and created based on the opinions of experts (a mathematics education specialist,

a science education specialist, a visual arts education specialist, an information technology education specialist, and a technology design education specialist).

## Results

**Activity Title:** Virtual Rectangular Prism Museum

**Grade Level for the Activity:** 5th grade

**Recommended Duration for the Activity:** 4 class hours

**Learning Outcomes:**

*Mathematics* (MEB, 2018a)

M.5.2.4.1. Recognizes rectangular prisms and identifies their fundamental elements.

M.5.2.4.2. Draws surface area configurations of rectangular prisms and determines whether given configurations belong to rectangular prisms.

*Science* (MEB, 2018b)

F.4.8.1.1. Defines a problem in daily life.

*a. The problem should aim to develop tools, objects, or systems used or encountered in daily life.*

*b. At this stage, the problem should be approached within the criteria of materials, time, and cost.*

F.4.8.1.2. Generates potential solutions for the problem and selects the appropriate one based on comparisons and criteria.

F.4.8.1.3. Designs and presents the product.

*a. Product design and construction should be done within the school environment.*

*Engineering* (MEB, 2018c)

TT.7.B.2.1. Makes draft drawings for his/her design.

TT.7.B.2.2. Converts draft drawings into two-dimensional visuals with the help of a computer.

TT.8.B.1.2. Converts draft drawings into three-dimensional visuals with the help of a computer.

TT.8.C.3.4. Designs a product using the engineering design process.

*Art* (MEB, 2018d)

G.6.1.2. Utilizes different materials and techniques when creating visual art.

G.6.1.4. Reflects ideas in visual art based on selected themes and subjects.

G.6.1.5. Uses perspective in visual art.

G.6.1.9. Applies art elements and design principles when creating visual art.

*Technology* (MEB, 2018e)

BT.5.D2.3. Uses information technology tools for research.

BT.3.D3.1. Conducts basic-level research on the internet.

BT.3.D4.1. Researches a topic using the internet.

BT.3.D4.2. Shares research findings with classmates in the classroom.

### Stages of the Activity

#### *Engagement Phase*

The teacher initiates the activity by captivating the students' attention through the presentation of various museum photographs, followed by a virtual tour of the Tales Mathematics Museum (Figure 2). Subsequently, the teacher engages the students with the following inquiries:

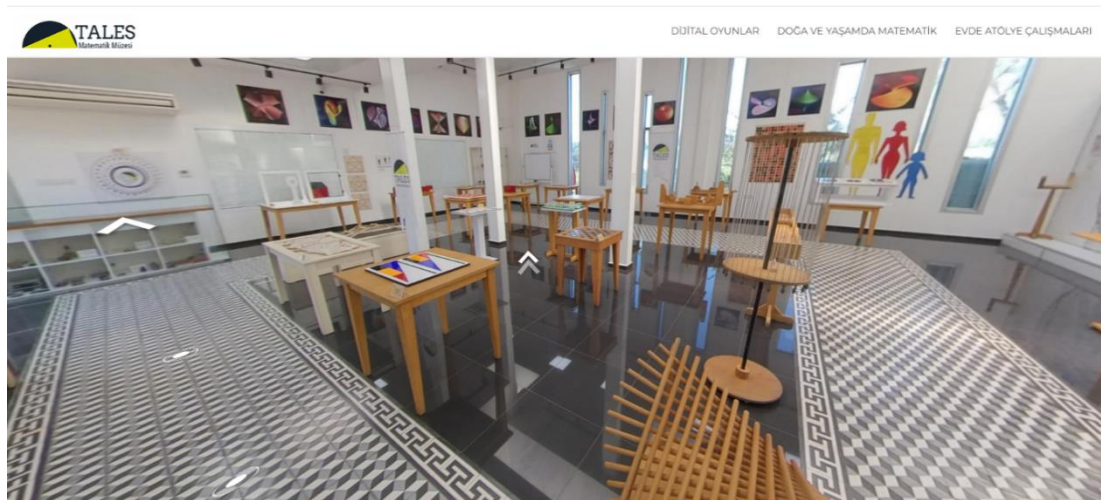


Figure 2. Tales Mathematics Museum (QNB Finans Bank Tales Mathematics Museum, 2021)

- Have you ever visited a museum before?
- What exhibits did the museums you visited showcase?
- Have you ever taken a virtual museum tour?
- Have you ever encountered a mathematics museum?
- If you were going to design a museum focused on rectangular prisms, what elements would you include?

Moreover, the teacher poses questions regarding the definition of a rectangular prism and its fundamental elements.

#### *Exploration Phase*

Building upon the responses gathered during the introduction, the teacher prompts the students to conduct research as part of the exploration stage. The students delve into the topic of rectangular prisms, their

fundamental elements, and surface area configurations while examining visual representations. Based on their research findings, the students create draft drawings depicting the characteristics and surface area configurations of rectangular prisms, subsequently utilizing the Paint 3D program to transform their drafts into three-dimensional models.

### ***Explanation Phase***

During this stage, the teacher facilitates a discussion based on the students' research and visuals, delving into the concept of rectangular prisms, their fundamental elements, and various surface area configurations. The students present their research and visuals to the class, allowing for a collective evaluation of their accuracy and completeness. Subsequently, the teacher explains, summarizing the topic and addressing any misconceptions.

### ***Elaboration Phase***

In this stage, the teacher informs the students that they will design a virtual museum dedicated to rectangular prisms. The students are divided into groups of five and, under the guidance of their teacher, proceed to design a virtual museum by creating user accounts on the "www.artsteps.com" website. Following a set of steps provided by the teacher (Figures 3-6), the students incorporate their drawings, non-copyrighted visuals, and information related to the characteristics, fundamental components, and surface area configurations of rectangular prisms. The information must be displayed upon clicking on the visuals. Additionally, the students pay attention to the principles of visual art design during the creation of their museum designs.

### ***Evaluation Phase***

Upon completing their virtual museums, the students generate links using websites that offer free QR code generation. These QR codes can be displayed within the school premises, providing access for all students to explore the virtual museum through the school's website and social media accounts. Utilizing virtual reality goggles and smartphones, students can embark on a virtual museum tour where they encounter photographs, three-dimensional visuals, and explanations related to rectangular prisms, their fundamental elements, and surface area configurations. The designs of the groups that complete their museums are evaluated by a committee comprising an art teacher, a science teacher, a mathematics teacher, a technology and design teacher, and an information technology teacher using the rubric form depicted in Figure 7.



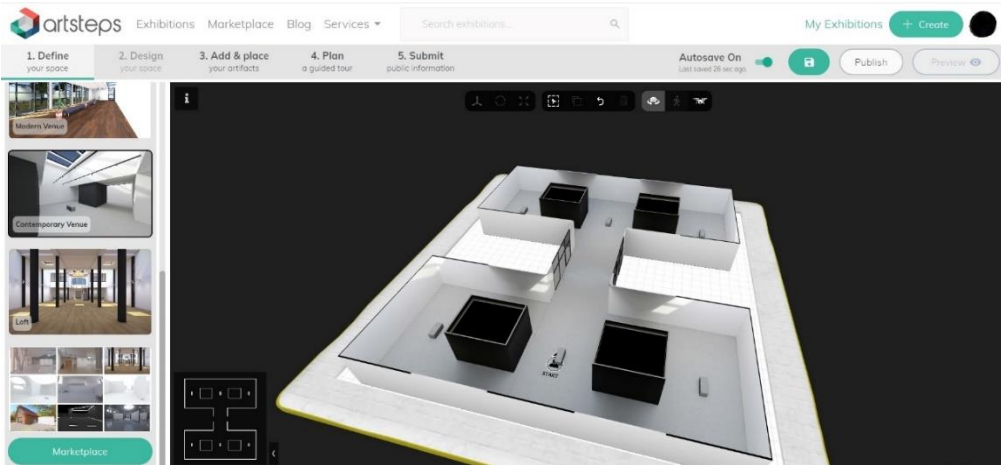


Figure 3. Designing the Museum

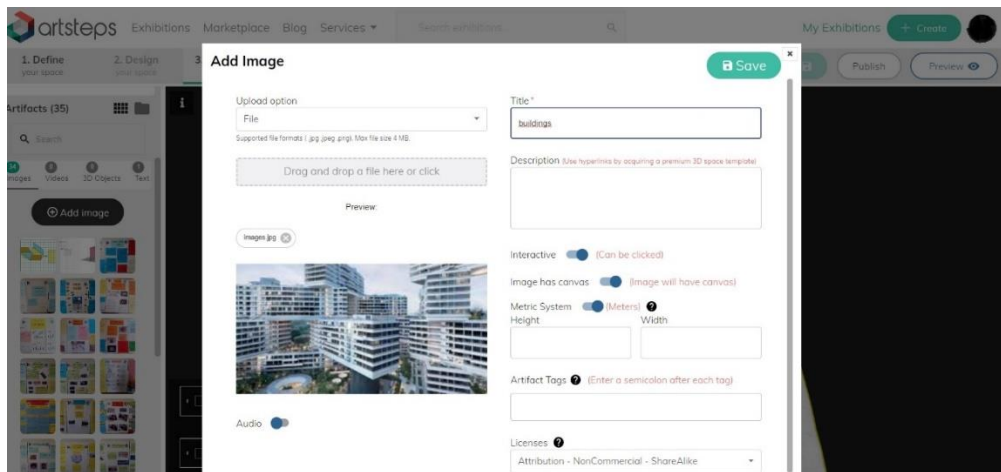


Figure 4. Uploading Images

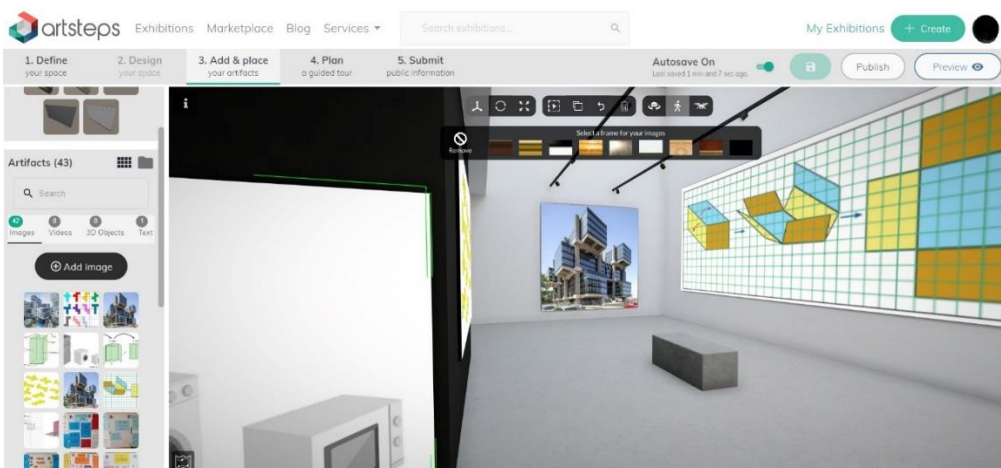


Figure 5. Adding Items



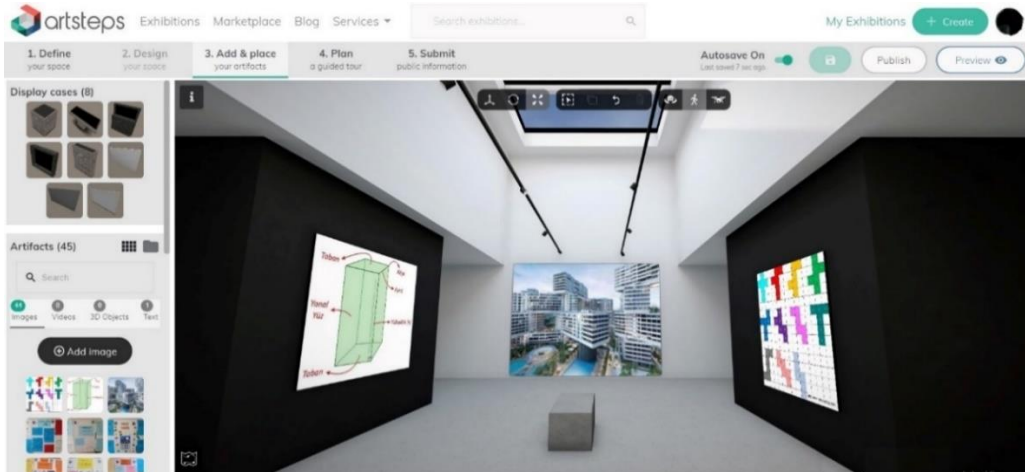


Figure 6. Preview of the Museum

Virtual Museum Design Rubric Evaluation Form					
Criteria	Scoring	1	2	3	4
<b>A Content</b>					
1	Is the subject and purpose of the museum clearly stated?				
2	Are the exhibited artworks or information relevant, accurate, and complete?				
3	Does the content offer variety and richness?				
<b>B Visual Design</b>					
1	Are the colors, graphics, and visual elements harmonious and appealing?				
2	Is the page layout and navigation user-friendly?				
3	Is visual hierarchy and emphasis used appropriately?				
<b>C Interactivity</b>					
1	Are there interactive elements for user engagement?				
2	Have interactive experiences been effectively utilized to enhance the learning experience?				
3	Is it easy for users to navigate between exhibits?				
<b>D Technical Implementation</b>					
1	Has the virtual museum been presented on a user-friendly platform?				
2	Are there any technical issues or errors present?				
3	Does it function smoothly on mobile devices and different browsers?				
<b>E Creativity</b>					
1	Does the design incorporate original and creative ideas?				
2	Does it demonstrate a unique and interesting approach to the museum experience?				
3	Are there original content and design elements utilized?				
<b>Scoring Scale</b>					
4: Excellent - The criterion is met exceptionally well.					
3: Good - The criterion is met satisfactorily.					
2: Needs Improvement - The criterion is partially met and requires improvement.					
1: Weak - The criterion is inadequately met and requires significant improvement.					

Figure 7. Evaluation Form

## Discussion and Conclusion

This study aims to present an activity proposal that is compatible with the STEAM approach and based on the 5E instructional model. The proposed activity focuses on designing a virtual museum of rectangular prisms and offers students the opportunity to gain knowledge and skills in Science, Technology, Engineering, Art, and Mathematics. In this study, the steps of a virtual museum activity developed in accordance with the STEAM approach are presented in detail. The activity aims to integrate the outcomes of science, technology, engineering, art, and mathematics disciplines in an interdisciplinary manner (Kennedy & Odell, 2014). In the process of transferring the outcomes related to the mathematics course to the students, students can use their

technology skills to acquire outcomes in this field. In addition, students can develop engineering skills by participating in the design process. In the activity, examining the rectangular prism, its fundamental elements, and different surface area configurations aims to increase students' acquisition of the rectangular prism. It is assumed that paying attention to visual elements in the design process will contribute to the development of students' competencies in the fields of art, technology, and engineering.

Since the STEAM activity was proposed in the study, it is limited in terms of concrete results regarding its impact on students. For this reason, in different studies, the effects on students can be examined by using the activity proposed in the study. This activity can be used as a sample lesson plan that effectively combines STEAM education and virtual learning tools. Educators can use this activity to develop students' STEAM skills and concretize mathematical concepts. In addition, this activity is also suitable for building students' research skills and developing their ability to use technology effectively. Going further, sharing virtual museum designs and encouraging students to visit each other's virtual museums can be encouraged (Karadeniz et al., 2015). This can enable students to learn from each other and exchange ideas in an interactive learning environment.

When the students have finished their virtual museums, they create links utilizing websites that provide free QR code generation. These QR codes can be put on the school premises, allowing all students to explore the virtual museum via the school's website and social media profiles. During the implementation process, after the activity is designed, the application of the site can be installed on mobile devices and placed on virtual reality glasses, allowing students to virtually walk around the museum. Thus, taking into account the fact that virtual museums are independent of space (Schweibenz, 2004), the number of participants who can visit the museum can be increased, and the event can be spread to large masses.

## Recommendations

This virtual museum activity, under the STEAM approach proposed in the study, was prepared according to the 5th-grade level in the subject of the rectangular prism. . Due to the dearth of such studies (Kızılay, 2021), similar activities can be developed and used at different grade levels, in different courses and subjects. In this context, virtual museums can be adapted to teaching methods other than the 5E Model in mathematics education. The activity proposed in this article has not yet been implemented. Therefore, it leaves room for future studies to investigate its impact on students.

## Acknowledgements or Notes

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\* The museum illustrations on this paper were obtained from the [www.artsteps.com](http://www.artsteps.com) website.

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