**Lesson Plan: African Ceremonial Masks**

**Project Overview**

*The* **Gateway to the Past** *project series offers students and teachers specific examples that illustrate how Autodesk software, in conjunction with a variety of prototyping technologies, can support students in developing a deeper understanding of history—people, events, cultures, and technology—through research leading to the re-creation and personal interpretation of historical artifacts. The significance of this series is captured in this statement by Smithsonian Institution anthropologist Daniel Miller: “Objects continually assert their presence as simultaneously material force and symbol. They frame the way we act in the world, as well as the way we think about the world. To understand the past, we have to understand the artifacts of the past.”*

In the African ceremonial mask project, students engage in the study of artifacts that have become critical cultural symbols across the globe. Professor John Emigh of Brown University writes “Masks and their manifold forms are a very significant mode of cultural expression. This is one of the many ways through which cultures have given voice to their powerful cognition and most subtle emotions, to define their inner and outer realities. Mask refers to the total personality of a person rather than an aspect of the self. It also refers to disguise that hides the real identity of a person.” The integration of Autodesk 123D Catch and Meshmixer will enable students to develop accurate 3D facial replications in virtual form that can be transformed to mimic the masks of specific cultures. These tools, in conjunction with technologies that include 3D printing and laser cutting, completely alter the time and skill level in both drawing and 3D fabrication that were traditionally required for a comprehensive study of masks. Research on historical masks serves as a stepping stone to critical thinking in which students must immerse themselves into a culture and time to imagine and create (virtually and/or physically) their own interpretations for masks.

**Sample Lesson:** The specific lesson for this topic involves the design and fabrication of a personal interpretation of a mask. Masks have been widely utilized for thousands of years in ceremonies to bring rain for crops, in manhood and fertility rituals, war dances, and more. They were often crafted in exquisite detail and many times composed of multiple materials such as wood, cloth, plants, dyes, and other natural materials. A technical video guides students through the process of recreating a ceremonial mask styled after real-world examples. This is accomplished by creating a virtual model in 123D Design, which can subsequently be translated into a physical artifact through 3D printing and/or laser cutting using 123D Make. The technical video and additional software tutorials available online are intended to empower students with the creative skills to take their project further by developing a personal interpretation of a ceremonial mask. **Like all the projects in this series, the specific lesson example is intended to illustrate the process that could be applied to any historical inquiry enhanced through artifact re-creation and personal interpretation.**

**Software**: Autodesk® 123D Design, (Options: Make Catch, Mesh Mixer, 3D printing)

**Time:** 8 to 10 hours  
**Subject(s):** Social Studies, History, Art Engineering, Art, Math, Science

**Grade Levels:** 9–12

**Key Concepts**

* Masks, like many other historical artifacts, have played a central role in culture, religion, and human society for thousands of years, and they reveal important information about how past peoples thought and lived.
* Historians and social scientists utilize historical artifacts to discover how societies operated, the technologies they employed, the values that shaped their culture, and the events that influenced subsequent cultures and historical periods.
* The field of archeology plays a critical role in the discovery, validation, and examination of artifacts that help illuminate historic events, civilizations, and their impact on the world.
* The tools and materials used by different cultures in the creation of original historic artifacts provide critical clues about a society in terms of its knowledge, technical capabilities, and connections to other societies.
* The ornamentation applied to many historic artifacts can provide valuable insights regarding the beliefs and value systems of a society.
* Software such as 123D Design can support learning and engagement by providing students with tools that enable them to re-create and/or re-interpret artifacts based on textbook content, original source documents, and/or existing artifacts.
* Software such as 123D Make, in conjunction with rapid prototyping technologies that include 3D printing and laser cutting, can be used to translate virtual models of historic artifact re-creations or interpretations into 3D physical models.

**Learning Outcomes:** As a result of engaging in this project, students will be able to:

* Describe the significance of masks in conveying information about a society’s beliefs and values.

* Articulate the importance of studying cultural artifacts in order to develop a deeper understanding of the past.
* Demonstrate skills in conducting historical research related to culture, religion, and art.

* Demonstrate skills in using Autodesk 123D software to create a mask in the style of African ceremonial masks.
* Demonstrate skills related to incorporating virtual and physical representations of historical artifacts into a variety of presentation formats that can include written essays, and oral and visual presentations.
* Demonstrate competence in effectively utilizing digital media.

**Prerequisites**If you have not used any of the Autodesk software before, we recommend that you view and test out the free online tutorials:

For **Autodesk 123D Design,** go to <http://www.123dapp.com/howto/design>

For **Autodesk 123D Make,** go to <http://www.123dapp.com/howto/make>

In order to complete the sample project, refer to the following technical videos:

* African Masks TV 1
* African Masks TV 2
* African Masks TV 3
* African Masks TV 4
* African Masks TV 5
* African Masks TV 6

**Key Terms**

***Historical artifact*** an object made by a human being, typically an item of cultural or historical interest such as a coin, tool, or mask.

***Archeology*** isthe study of human history and prehistory through the excavation of sites and the analysis of artifacts and other physical remains.

**Ceremony** is a cultural or ceremonial event performed to mark a special occasion. Ceremonies often incorporate religious elements and can mark events in individuals’ lives, or important calendar dates.

***Composition*** refers to the design layout of an object, and relates to important elements of the object, such as lines of symmetry or feature placement.

***Stylized*** objects do not portray objects in a realistic manner, but instead make use of creative, symbolic, exaggerated, or embellished visual elements.

***Death masks*** were used in death ceremonies, buried with the dead, or served as reminders of mortality. Sometimes they were crafted to bear the likeness of an individual, and at other times they represented a god or even death itself.

**Key Terms: Autodesk 123D Design  
  
*Gallery*** contains examples of models completed in 123D Design.

***Groups*** contain one or more objects, as well as other groups.

***Intelligent snapping*** allows a 2D or 3D primitive to be dragged onto any geometry and snap to the nearest face or edge.

***Kits*** contains custom parts and pre-built kits.

***Navigation tools*** are used to move around the scene. These include, pan, orbit, and zoom.

***Patterns*** create circular, rectangular, path, and mirrored patterns.

***Redo*** is a command that allows the user to return to a previous action that had previously been removed through the Undo command.

***Select Based Options*** displays only the relevant options based on the selected 2D or 3D primitive.

***Undo*** is a command that enables the user to remove up to 30 of the last actions taken in Autodesk 123D Design*.*

***View cube*** is used to look at and orbit around the scene.

**Discussion Guide**

**Essential Project Conceptual Questions**

* Why are rituals and ceremonies found in nearly every culture around the globe? How are they used? What similarities and differences can you see by comparing rituals?
* Why is the study of artifacts considered to be an extremely valuable aspect of research in the fields of history and social studies?
* What types of insights about a society might be apparent from examining ceremonial masks and considering their functional, aesthetic, religious purposes?
* What types of insights can the materials and methods of fabrication that were used to originally create an artifact reveal about a culture and historic time period?

**Essential Project Design Questions**

* What is the purpose of the object you are designing?
* What shapes and sizes are representative of African ceremonial masks?
* What do we know about how and when African societies used ceremony and rituals?
* What cultural elements should a ceremonial mask incorporate?
* What different materials were used to create African ceremonial masks?
* What literature exists on African ceremonial masks?
* How has the design of ceremonial masks evolved over time until today?
* What decorative ornamentation should a ceremonial mask incorporate?
* What process will be used to craft the mask?

**Teacher Preparation**

1. Read the Design Thinking Guide.
2. Review the technical videos associated with each lesson.
3. Be prepared to partner with your students in learning the new software techniques.
4. Show students how to find help in the curriculum and use the software Help feature.
5. Point out which videos the students need to catch up on if they need reference.

**Day-to-Day Plans**

**As noted at the start of this lesson plan, the specific project presented below and documented in the accompanying technical videos is intended to illustrate the process that could be applied to any historical inquiry enhanced through artifact re-creation and personal interpretation.**

**Hours 1–2:**

**Understand: *Watch and Listen***   
To establish a solid foundation for the ceremonial mask project, students need to have a clear understanding about the importance of research involving historical artifacts. The best starting point is to carefully review the project design brief. Distribute the student pre-test and have students spend 10 to 20 minutes developing their responses to the questions. Your next job is to facilitate a student discussion built around the pre-test questions. These can be conducted as a full class or small group discussions. As outlined in the project brief, the primary goal of this phase is for your students to establish an understanding of the purpose and meaning behind the ceremonial mask.

**Explore: *Develop a Knowledge Base***Through the Explore process, you want students to develop an understanding of the society that they are studying and the practical and symbolic value of the artifact(s) to be reinterpreted. A good place to start is to form teams in which students can discuss the essential project conceptual and design questions listed above.

**Define: *Clarify Requirements***

This critical stage in the design process involves establishing the criteria for the project. In order to create an historically accurate and relevant interpretation of a ceremonial mask, you need to understand specific parameters related to factors such as cultural context, ceremonial purpose, dimensions, materials used, construction techniques, color schemes, and symbols applied to masks.

**Note**: *Open the Design Criteria Worksheet to help you in completing the Define and Explore phases.*

**Hours 3–4**

**Ideate: *Creativity***In order to develop their own interpretive design for an artifact that is historically accurate with respect to the time period under consideration, students must base their interpretive design on the criteria that they have documented in the Define stage. This means they have completed their research in order to subsequently justify why their design would have reflected the values and technological capabilities of the selected historic period. Students can initiate the Ideate stage in a number of ways: by developing sketches on paper, building quick study models out of materials like paper or clay, or just simply start by using 123D Design. The goal is to get students to visually communicate to themselves and others the essential direction that they will take and refine in the next phase of prototyping.

**Prototype: *Test***In this phase, students translate key concepts derived from the Ideate phase into virtual and possibly physical prototypes with the software. Students can watch the technical learning videos, explore the datasets from the example project, and refer back to the online tutorials as they learn the skills that transform their concepts into reality. Encourage students to assist each other in learning the software.

**Hours 5– 6**

**Refine: *Almost There***In this phase, you want your students to leverage the power of the software to refine aspects of the design. As students proceed through this phase, remind them to keep referring back to the basic criteria that they previously established. Encourage students to carefully consider whether their interpretation of a ceremonial mask is authentic and relevant to the time period being studied.

**Solution: *Final Presentation***This phase is vital in preparing students for future success in school, careers, and life in general. The Solution phase is when you ask students to demonstrate how this project has helped them expand and enhance the *four Cs* of their learning and innovation skills: critical thinking, communication, collaboration, and creativity.

Instruct the students to prepare and conduct small group presentations that capture the important aspects of each of the previous phases. Ideally, students should be aware from the outset that the results of their efforts in design phases 1–7 will culminate in a final presentation.

**Note**: Emphasize that a successful presentation must clearly define the problem that guided the design and articulate the key criteria that are addressed in the solution.

Stress the importance ofusing software tools to visualize, animate, and present in the same way that real professionals do every day.Remind students that many colleges, universities, and employers place high value on digital portfolios that convey how a student thinks, works with others, generates creative solutions, and communicates ideas and knowledge through a variety of written, visual, and oral formats. By investing effort into this project, your students will be one step closer to their goals for careers and/or college.

**Note**:If time is limited, you may opt to have students share their final presentations electronically. This provides an opportunity to generate feedback from peers and teachers.

**Differentiated Instruction**

* Encourage students to review the lesson and skills videos in small groups.
* Have small teams of students collaborate to complete one design criteria matrix by dividing up the work.
* Identify specific websites that students can use for the Define and Explore stages.
* Provide some students with a set of predefined design criteria and background content to modify the Define and Explore stages.
* Have small groups collaborate on the Ideate, Refine, Prototype, and Presentation stages. Have some students focus on the development of physical sketches and sketch models while collaborating with team members who focus on digital prototyping.
* Provide students with self and peer evaluation forms to be filled out at the completion of each phase.
* Provide students with models of successful student presentations with clear examples of each design phase.

**Non-Native Speakers**

* Encourage students to tap into their own culture and life experience to discover prior knowledge of the project topic.
* Provide English/first language translation dictionaries and/or electronic translation devices.
* Allow the students to prepare materials in their primary languages and have them translated later.
* Pair ELL students with native English speakers.
* Provide a translator for viewing of videos.

**Special Needs Students**

* Provide prefabricated modeling components.
* Engage the help of aides to assist in physical sketch modeling and prototypes.
* Accommodate students by allowing additional time and/or reducing the scope of project requirements.
* Provide any necessary accommodations for access to technology such as alternative input devices, larger font sizes, speech recognition, and so on.

**STEAM Connections**

**Background**

STEAM stands for the integration of science, technology, engineering, art, and math. The study of historical artifacts provides a perfect window into the past, revealing the roles that these key domains of skill and knowledge played in a particular society and time period.

Science

* Determining the time period in which historical artifacts originated is crucial to drawing accurate conclusions about the people who made it, the environment in which it arose, and the technologies used to produce it. One tool scientists can use is a process known as carbon dating, which can ascertain relatively precisely the age of organic objects such as bone and wood. Examine the process of carbon dating in depth and consider the following questions:
  + What are isotopes?
  + What is a half-life?
  + How can measuring the relative proportions of isotopes in an object help determine the age of the object?
  + Does the same process work for determining the age of inanimate objects such as rocks or sea water?
  + What other applications does carbon dating have?

Technology

* Some people collected or even grew plants in order to obtain pigments, as many roots and leaves can be treated and prepared to produce dyes. For example, a plant called woad produces blue dyes that can be extracted from its leaves. The pigment extracted from the roots of other plants can create beautiful indigos and reds. Often, the process of creating the paint took many steps and utilized the fire, the sun, evaporation, concentration, and agriculture. What technologies are required to make the different pigments used to add color to and adorn intricate African masks?
* Some African societies, such as the Ligbi people, carve masks out of wood using stone and metal axes, knives, and files. Less commonly, other African cultures create masks cast from metal, and still others used ceramic or pottery to fashion their masks. Examine the eighteenth-century geographic distribution of technologies such as pottery, metalworking, and wood carving throughout Africa. Consider how physical geography impacts trade linkages, and consequently, access to different technological innovations.

Engineering

* Woods from different trees can have very different properties. The Ligbi people, for example, made masks carved from mostly West African hardwood trees. Musical instruments from Africa, on the other hand, are often made from softwood trees. Examine the different categories of trees. What are the biggest differences in size, shape, habitat, etc. between hardwoods and softwoods?
* Some masks were actually headdresses that served to entirely obscure the human wearer. Other masks could be attached to the back of the face, and still others were meant to be held to in place by the wearer, using a handle at the bottom or on the side. Investigate the form and function of the straps or design features meant to fasten masks to the wearer’s body.

Art

* Song and dance are ubiquitous as forms of expression throughout human societies around the world, and the types and styles of music and dance are almost too numerous to count. In many traditional African ceremonies, dancing and drums played a supporting role when, during a ritual, a mask-wearing member of the society would part with his or her personal identity and become inhabited by the spirit of a god or ancestor. How is the music an important part of the ceremony? What function does it serve? Investigate what West African music sounded like during such ceremonies and the instruments used to create it.
* African ceremonial masks often evoke highly stylized human or animal faces. According to the beliefs of many African societies, when an individual put on an animal mask during a ritual or ceremony, he or she embodied the spirit of the animal and could communicate directly with that species. Humans used such ceremonies to request a good hunt or protection from predators. Choose an animal that is represented in African masks, and investigate why this animal is so important to a particular society. In what other African art does the animal appear, and in what contexts?

Math

* Many ceremonies and rituals revolved around the calendar, seasons, agriculture, and weather. Keeping track of the time of the year was absolutely essential to deciding when to plant and harvest crops, tracking and hunting animals, marking holidays and celebrations, and trading with or meeting other peoples. Investigate different kinds of calendars used by different African peoples. In what ways are they similar among different nations? In what ways do they differ?
* Consider your specific mask design, both its shape and the material from which it is made. Using math skills and Autodesk software, first determine the total volume of the mask. Next, based on the volume and the density of the proposed materials, formulate a best estimate of the weight of the finished ceremonial mask. Weigh that out in the real world. Is your design feasible?

**Alignment with Math and Science**

The accompanying Math and Science matrices provide the teacher with suggestions regarding various concepts and operations that could be presented and reinforced through the projects

**Science and Math Matrices**

Projects in the Digital STEAM Workshop create opportunities for teachers and students to connect concepts in Math and Science to real-world projects. For example, with the African Mask project student can explore the mathematical concepts of scale and proportion.

**Math Matrix**

|  |  |  |
| --- | --- | --- |
| **Grade 7** | **Grade 8** | **Algebra I** |
| Area | Ratios and proportions | Systems of linear equations |
| Volume | Area | Ratios and proportions |
| Ratios and proportions | Volume | Area |
| Modeling | Transformations | Volume |
|  | Tessellations | Transformations |
|  | Systems of linear equations | Tessellations |

|  |  |  |
| --- | --- | --- |
| **Geometry** | **Algebra II** | **Trigonometry** |
| Area | Systems of linear equations | Use of vectors |
| Volume | Modeling | Determine forces acting on materials and objects |
| Transformations | Linear inequalities | Determine distances, speed, acceleration |
| Calculating measurements indirectly | Right triangle trigonometry | Triangle trigonometry for indirect measurement |
| Cartesian coordinates | Cartesian coordinates | Coordinates: Cartesian, polar |
| Right triangle trigonometry | Production costs of modular parts |  |

**Science Matrix**

|  |  |
| --- | --- |
| Materials and material finishes | Biomimicry |
| Chemistry of pigments and dyes | Zoology |
| Preservation of historical artifacts | Makeup of molecules |
| Interchangeable materials | Chemical composition of recycled content |
| Archeology and anthropology | Chemistry of production process |
| Strength and weight of materials | Ergonomics |

**Build It**  
When you ask adults what they remember most about school, the answer often refers to something they produced―something they built, wrote, performed, or generated through some form of visual media. Such activities can take extra time, but the benefits are worth it.

**Extension Ideas**

* Use Autodesk® 123D Design software, Catch, and Meshmixer to develop a variety of mask designs and produce these using 3D printing.

**Assessment Processes**  
The assessment process for all of the projects in this curriculum provides students with formative feedback for each of the seven essential phases. The rubrics that are included as a separate document guide students in knowing what is expected for each phase and the criteria used to evaluate the quality of the work. For each project, students complete a self and peer evaluation. These include a reflective narration for each phase, accompanied by a point score derived from the rubric. These evaluations are accompanied by a teacher evaluation that also includes a narrative and numerical score for each phase along with a cumulative score. The STEAM questions, Extension Ideas, and the optional Build It activity offer students an opportunity to take what they learn in the assessment process and apply that knowledge to enhance the quality of their work and increase their scores.