**Lesson Plan: Coins: Purpose and Meaning**

**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, examining 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 1864, Charles Meggs of Oxford University wrote, “Antiquity has left no monuments of its living form and character at all comparable in number and variety to its coins and medals... They constitute thus a most complete cabinet of illustrations, in which the whole body, soul and spirit of the ancient world is still visible in its beautiful life.” His comments are echoed in contemporary times by Professor Martin Daunton, Director of the Fitzwilliam Museum, Cambridge, UK. Daunton writes, “In the field of Classical Studies, in particular, where the quantity of sources is very restricted, coins constitute a major body of historical, economic and artistic material and evidence. The surviving coins by far outnumber other groups of sources such as ceramics and inscriptions, and contrary to most other classical remains they automatically mirror the public sphere, as by definition their value and acceptance must be guaranteed by the state. So coins—both in themselves and in the context of hoards—are not only sources for economic history or just a medium for art work, but they can also give extensive information about official religion and cult, political thought, ideology and autonomous artistic features such as portraiture, as well as monetary policy.”

Research about coins and currency, through texts and references to original source documents, leads students into designing their own interpretation of coins linked to a particular culture and time. Autodesk software then supports the crucially important process of critical thinking. Students must use their knowledge of the selected culture and time period to develop designs for coins that are relevant to the society, its material and spiritual values, technological capabilities, and methods of conducting commerce.

**Sample Lesson**

The specific Lesson for this topic involves the design and fabrication of an ancient Chinese coin. The diverse range of designs and materials used in coins around the world tell us a great deal about the cultures and peoples who created them. They reflect the cultural values, economic conditions, aesthetic tendencies, and technological abilities of a society. In some cases, money and currency formed a fundamental pillar of society, while in others, it played a marginal role or did not exist at all. A technical video leads students through the steps of creating a 3D model of a coin. After students complete the sample coin, they are asked to pick a culture and a time period and then think carefully about how to incorporate foundational elements of the time and culture into an imaginary design of a coin from that place and time. The student will create his or her own virtual model in Autodesk 123D Design, which can subsequently be translated into a physical artifact replica through 3D printing and/or laser cutting using Autodesk 123D Make. The technical video and additional software tutorial available online are intended to empower students with the creative skills to take their project further by developing a personal interpretation of a historical coin. **Like all the projects in this series, the specific lesson example is intended to be illustrative of 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, Meshmixer, 3D printing)

**Time: 1-**5 hours   
**Subject(s):** Social Studies, History, Art Engineering, Art, Math, Science

**Grade Levels:** 9–12

**Key Concepts**

* Historians and social scientists study 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 such as coins that help illuminate historic events, civilizations, and their impact on the world.
* The tools and materials that were used in the original creation of historic artifacts provide critical clues about a society in terms of its knowledge, technical capabilities, and connections to other societies.
* The functional and aesthetic qualities of historical artifacts such as coins convey extensive information about a civilization’s economy, its trade connections and practices, and the commodities it valued.
* The ornamentation incorporated into currency can provide valuable insights regarding the religious, social beliefs, and value systems of a society.
* Software such as Autodesk 123D Design can support learning and engagement by providing students with tools that enable them to re-create and/or reinterpret 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**

By the end of this lesson, students will be able to:

* Articulate the importance of studying historical artifacts in order to develop a deeper understanding of the past.
* Demonstrate skills in conducting historical research related to currency design.
* Demonstrate skills in using Autodesk 123D software to create an historically and culturally relevant coin design.
* Think critically about the design and aesthetic aspects of money.
* Articulate an understanding of basic concepts about economics, currency, and exchange.
* 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:

* Ancient Chinese Coins LV 1
* Ancient Chinese Coins LV 2
* Ancient Chinese Coins LV 3
* Ancient Chinese Coins LV 4

**Key Terms**

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

***Currency*** is any money used as a medium of exchange. It can refer to the name of the money in any given country (dollars, pounds, euros, yuan, etc.).

***Economics*** is the study of the allocation of resources, currency, and trade.

***Alloys*** are composite mixtures of two or more metals combined into one, generally for its specific properties.

***Denomination*** is the face value of a coin, bill, or other money. Different denominations of the currency represent different amounts of money.

***Minting*** is the process of making a coin by stamping metal.

**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 prebuilt 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 allows 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 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 societies can be gained by studying the coins, money, trade, and economies of ancient civilizations?
* 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?
* What types of insights might currency reveal about the distances and ways in which people of one society traveled and traded with other societies they came into contact with as trade partners or rivals?
* Why do coins and currency occupy a privileged niche as excellent reflections of society, cultural beliefs, and government?

**Essential Project Design Questions**

* What ancient coinage has been recovered by archeologists and historians?
* What are the design features currency should have to serve not only its primary functional purpose but other cultural or symbolic purposes as well?
* How were coins in early China manufactured?
* What types of materials were used to make early coins?
* What can coins and money tell us about the lives of the individuals who used them?
* How did markets and commerce change over time? In what ways did that affect the form of currency?
* Why was currency created? What advantages does a money system have over a system of bartering or direct exchange of goods and services?

**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 how to 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 ancient coin 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 historical coins.

**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 coin, you will need to understand specific parameters related to factors such as dimensions, materials used, construction techniques, color schemes, and symbols as applied to money.

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 period being studied, students must base their interpretive design on the criteria that they have documented in the Define stage. This means they have completed their research and can subsequently justify why their design reflects 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 such as paper or clay, or they can 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 currency 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 the basic criteria that they previously established. Encourage students to engage in a mental practice of asking themselves whether their historical artifact interpretation could have conceivably existed during the time period being studied.

Solution: Final Presentation   
This phase is vital for 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 of using software tools to visualize, animate, and present in the same way 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 teacher.

**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 student to prepare materials in their primary language and have it 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 to help reveal the roles that these key domains of skill and knowledge played in a particular society and time period.

**Science**

* In nearly all instances, metal coins are made by heating the metal to many hundreds of degrees until it is soft enough to pour into a mold or shape with other tools. Investigate what happens at the atomic level when metal is heated and melted. Why does it lose its rigid shape and soften into a liquid? What happens as a metal cools and hardens again?
* Dozens of different kinds of metals have been used to create coins. Many early coins were forged from of precious metals such as gold and silver, while China helped popularize other cheaper metals such as bronze as material for coins. Today, rather than being crafted from only one metal, coins may be made of alloys, chemical mixtures of two or more metals.
  + Investigate the physical and chemical properties of alloys. What advantages do alloys have over pure metals?
  + Investigate the kinds of alloys the European Union uses to mint its euro coins. What physical and chemical characteristics do these alloys exhibit that may have influenced this choice of material?

**Technology**

* Currency has been made from literally hundreds of materials. In Micronesia—an area of hundreds of small islands north of Australia and east of the Philippines—people made huge stone coins as large as eight feet across. In Africa, painted glass beads were a major currency in the slave trade. Metal coins date back to ancient times and their use endures today. Most of the world now uses paper money as well. What does the choice of material for the currency tell you about the culture’s technology? What technology is required to manufacture the currency? What technical competencies and production techniques did the culture have to develop to mass produce the currency?

* Currency is a tool, sometimes quite literally. In early China people used shovel-shaped currency as money. Early spade currency was sometimes only a little smaller than a regular shovel. Other coins were shaped like knives— some were pointed, others curved, and some were straight like a razor. What do these coins tell us about the technology of the civilization? What does it tell us about the importance of the tools the coins depict?

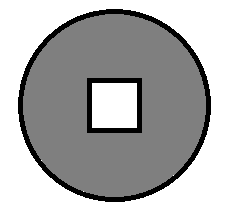
**Engineering**

* Sea shells have been a prized commodity around the globe for millions of people for thousands of years. Cultures in North America, the Pacific, China, Africa, and Europe all valued shells and in many cases, people literally used them as currency. Consider why that might be. What properties do sea shells have the make them well-suited to being used as money? What other functions would shells serve? What design features do you see in the shells that could be incorporated into your man-made currency? Choose a continent and investigate shell currency there.
* Over time, currency from various cultures evolved, shrinking in size and including spade coins of different sizes and weights to represent different denominations. Think about why the “coins” started out so big. Why did they shrink? What technological forces do you think contributed to the shift? What functional factors? What cultural factors?

**Art**

* Coins and currency are perfect vehicles to showcase the exciting intersection of form and function, art and engineering. Find a one-dollar bill and examine the intricate artwork on the front and the back. Find as many artistic elements as you can identify and consider the artistic process that went into creating the finished artwork on the bill. How does the art enhance, contribute, and support the functional aspects of money?
* Today, coin designs are etched into large circular plates and then copied over and over into smaller plates until a precise, exquisitely detail, and much smaller coin-sized image remains. By contrast, in ancient times, the amount of detail that could be achieved was limited by having to create the art on the scale of the coin. How would the ability to include more or less detail influence the artwork found on coins? Which method—working on an enlarged scale or on the scale of a coin—lends itself better to stylized figures? Realistic landscapes?

**Math**

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* Consider the shape of a traditional Chinese coin, circular with a square cut out of the center. The diameter of the coin is 1 inch. The square is 1/3 inch x 1/3 inch. How many square inches of metal are required to craft this coin?
* To utilize currency efficiently, cultures must have a sufficiently advanced understanding of mathematics and numbers. Number systems around the world use different bases. We use a base-10 number system called the decimal system, meaning we count in units of 10s (10, 20, 30, etc.). The ancient Babylonians used a base-60 system called the sexagesimal system. Why might different number systems exist? What might be some advantages to a base-60 system as opposed to our base 10? Why do you think we chose a base-10 system? Research a different number system from another culture. What currency designs would suit this number system?

**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 this coin, students could develop algebra projects around variables such as weight, material volume, denominations of currency, etc. The functional and aesthetic design features such as the decoration on the faces of a coin or the shape of the coin can be directly linked to knowledge of geometry. Research projects that ask science questions about ancient money could investigate the process of forging ancient metal coins, state-of-the-art minting technology, material properties, volume of 3D coin designs, and even economics.

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 | Systems of linear equations | Volume |
| Graphing | Currency | Quadratic equations |
| Currency |  |  |

|  |  |  |
| --- | --- | --- |
| Geometry | Algebra II | Trigonometry |
| Area | Systems of linear equations | Use of vectors |
| Volume | Modeling | Determine forces acting on materials and objects |
| Cylinders | 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 |  |

|  |  |
| --- | --- |
| Pre-Calculus | Calculus |
| Linear equations | Area of complex shapes |
| Inequalities | Volume of complex shapes |
| Multivariable equations | Forces |
| Trigonometry | Vectors |
| Calculating indirect measurements | Optimization |

**Science Matrix**

|  |  |
| --- | --- |
| Chemical changes during production | Archeology |
| Materials and material finishes | Preservation techniques |
| Resistance to corrosion | Economics |
| Inks and dyes | Chemical composition of coin metals |
| Makeup of molecules | Strength and weight of materials |

**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 to develop currency from other cultures .

**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.