**Lesson Plan: Macbeth Crown**

**Project Overview**

**Overview**

*In the* ***English Language Arts Series****, students and teachers are presented with opportunities to leverage the capabilities of Autodesk software to enhance learning activities related to reading, speaking, writing, and listening. The comprehensive set of 2D and 3D visualization tools provide learners access to a powerful digital medium for expressing ideas, articulating knowledge, and conveying interpretations of literary and informational text. Sample l willesson plans are offered to inspire teachers and students and to provide a foundation of technical skills that can subsequently enhance any Language Arts learning activity.*

Metaphor is one of the most important of literary uses of language, and Shakespeare is probably the world’s greatest master of using this powerful device. In drama, metaphors appear not only in the text spoken by the characters, but also in reference to the characters' actions and props. Even the titles and settings of plays are often metaphorical. The use of props as metaphors can then be used to deepen the meaning of the text. In the process of reading a dramatic work, students are asked to consider how the text and the meanings that the author is attempting to convey could be translated through the design of props that might be used in a stage production. The traditional barriers of time, money, design, and fabrication skills are transcended by the application of Autodesk 2D and 3D technologies. Students can now expand and enhance their writings and presentations through the integration of visual images and physical artifacts.

**Sample Lesson:** Considered one of Shakespeare's most iconic plays, *Macbeth* is replete with metaphor expressing interrelated themes including blind ambition, damnation, prophecy, and moral order. His desire to be king comes at an enormous price. In this sample lesson, students explore Shakespeare’s text using passages of the play to support the validity of the design for a crown that could be used as a stage prop. A technical video steps students through the process of creating a crown inspired by the text. This is accomplished by generating a model in 123D design and modifying it in Meshmixer. An extension to this project entails translating virtual models into a physical artifact replica through 3D printing and/or laser cutting using 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. **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 guided through artifact re-creation and personal interpretation.**

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

**Time:** 5 hours

**Subject(s):** Social Studies, History, Art Engineering, Art, Math, Science

**Grade Levels:** 9–12

**Key Concepts**

* Symbols are objects, characters, figures, and colors used to represent abstract ideas or concepts. Shakespeare was a master in using symbolism throughout all of his literary works. In this sample lesson, the design of Macbeth’s crown for a stage production can symbolize many of the overarching themes in *Macbeth*.
* Shakespeare made extensive use of metaphors in *Macbeth*. Metaphors represent the direct substitution of one idea or object for another and can be expressed not only in the text spoken by the characters, but also through the characters' actions and props. The following well-known passage from *Macbeth* provides a classic example of metaphor: "Life's but a walking shadow, a poor player that struts and frets his hour upon the stage and then is heard no more. It is a tale told by an idiot, full of sound and fury, signifying nothing" (Act V, Scene V).
* Several key literary motifs recur throughout Shakespeare’s *Macbeth*. These include:

*Visions and hallucinations*: The floating dagger, the three sisters, the ghost of Banquo.

*Violence*: Blood and carnage predominate in this tragic drama. From the outset, Macbeth and Banquo are “wading in blood on the battlefield”; murders occur throughout the play, which ends with Macduff beheading Macbeth.

*Prophecy*: The witches make several key prophecies that guide the development of Macbeth ambitious path towards becoming king and his eventual demise; the confounding prophecies are fulfilled.

* Macbeth’s quest for the crown, fueled by the maniacal desires of Lady Macbeth, serves as a moral tale regarding the pitfalls of blind ambition.
* Software such as 123D Design provide students with an accessible means of creating visual images that can be used to help articulate their insights regarding literary works.
* Software such as 123D Make in conjunction with 123D Design enable students to create three-dimensional artifacts that can enhance presentations or serve as props for modern interpretations for theatrical productions of Shakespeare’s *Macbeth*.

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

* Articulate the importance of metaphor as a literary device in drama.
* Describe major themes and associated metaphors in Shakespeare’s *Macbeth*.

* Demonstrate skills in using Autodesk 123D Software to create virtual and perhaps physical models of metaphorical props.
* Explain the linkages between their personally created prop and the author's intent.
* Demonstrate skills related to incorporating virtual or physical representations of metaphorical props into a variety of presentation formats that can include written essays, and oral and visual presentations.
* Demonstrate competence in effectively utilizing digital media.

**Prerequisites**Have the students watch these Digital Study Packet videos to prepare for the project:

* Dramatic Props LV 1
* Dramatic Props LV 2
* Dramatic Props LV 3
* Dramatic Props LV 4
* Dramatic Props LV 5
* Dramatic Props LV 6
* Dramatic Props LV 7

**Key Terms**

***Acheron*** Hell; one of the rivers in Hades.

***Apparition*** A ghost or ghostlike image of a person or animal.

***Augur*** To foresee or predict the future.

**Equivocation** To say one thing while meaning something different; to use ambiguous language so as to conceal the truth or to avoid categorical statements.

**Extemporize** To improvise; to perform or produce something such as a speech or piece of music on the spot.

***Literary symbol*** Something that represents something else by association, resemblance, or convention, especially a material object used to represent something invisible.

***Metaphor***A figure of speech in which a word or phrase that ordinarily designates one thing is used to designate another, thus making an implicit comparison.

***Parricide*** The killing of a parent or near relative.

***Precocious*** Showing intelligence or abilities at a younger age than usual (said of children, such as Macduff's son).

***Rancor*** Bitter, especially longstanding resentfulness.

***Regicide*** The killing of a king.

***Scansion*** The rhythm of a line of verse; the act of scanning a line to determine its rhythm.

***Syncopate*** To displace the beats in music or speech, so as to reverse the order of strong and weak beats.

***Tragic flaw*** A fatal flaw in one's character, usually leading to the downfall of the hero or heroine. Also known by the Greek term *hamartia*.

***Yoke*** A crossbar or crosspiece that joins two animals in farming; often used as a symbol of oppression or bonding.

**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*** 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 to 30 of the last actions taken in Autodesk 123D Design*.*

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

**Discussion Guide**

**Essential Project Conceptual Questions**

* In what ways might have attitudes about the supernatural during the Renaissance influence Shakespeare’s use of the opposing themes of fate and one’s control in determining their future?
* What were the key prophecies of the witches, and why were they crucial to this play?
* How does Lady Macbeth influence Macbeth’s decisions and actions?
* Would Macbeth have blindly pursued the crown by killing if he was not haunted by the witch’s prophecies?
* In what ways was Shakespeare using Macbeth to illuminate the connection between a king and the health and prosperity of his country?
* Ultimately, are we responsible for the outcomes of our own lives or are there certain circumstances that lie beyond our control?

**Essential Project Design Questions**

* What does Macbeth’s use of the phrase “fruitless crown” mean in the line lines from Act 1 scene 3:

“They hail'd him father to a line of kings:   
Upon my head they placed a fruitless crown,    
And put a barren sceptre in my gripe,   
Thence to be wrench'd with an unlineal hand,   
No son of mine succeeding.”

* How can the theme of blind ambition be integrated into the design of Macbeth crown?
* How could the image of blood and the theme of fate be incorporated into the design of Macbeth’s crown?
* How might Lady Macbeth’s desires for her husband to become king influence the design of Macbeth’s crown?
* How the choice of materials and surface finish for a crown design might be used to evoke the major themes of *Macbeth*?

**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 Macbeth crown project, students need to have a clear understanding about Shakespeare and the major themes in this particular play that could be symbolized in the design of a crown for a theatrical production. 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 meaning of *Macbeth* as a literary work.

**Explore: *Develop a Knowledge Base***Through the Explore process, you want students to develop an understanding of the major themes, characters, and symbols that are central to Shakespeare’s *Macbeth*. 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 a symbolically rich crown design for a theatrical production of Macbeth, students need to understand specific parameters related to factors such as dimensions, materials used, construction techniques, color schemes, and symbols applied to shields.

**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 the crown, students must base their interpretive design on the criteria that they have documented in the Define stage. 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 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 the basic criteria that they previously established. Encourage students to engage in a mental practice of asking themselves whether their crown design conveys several major themes of the play.

**Solution: *Final Presentation***This phase is vital for preparing students for future success in school, careers, and life in general. The Solution phase is where 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 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. In his writings, Shakespeare often references the state of knowledge of these disciplines throughout various periods of history.

Science

* Review the classic story of Archimedes' principle and the golden crown. In order for Archimedes' method to work, there are a number of assumptions that must be made. Write a list of all of the necessary assumptions, and justify each.
* Crowns and jewelry are often decorated with precious gems. Investigate various natural and synthetic gems structure, properties, and uses. What makes certain gems more valuable than others?

Technology

* In the technical videos, the crown was printed on a fused deposition printer, which is only one of the many 3D printing methods on the market. Investigate different 3D printing methods, select the one you believe would be the best for printing your prop, and justify your answer.
* The historical king Macbeth ruled in Scotland from 1040–1057, and the literary drama *Macbeth* is set in the eleventh century. What types of technologies were used in the military at that time? How would those technologies have been used by Macbeth in the beginning of the play’s battle scene?

Engineering

* Many similarities exist between functional prototyping and prop making. Compare and contrast techniques, materials, and purposes.
* Gold and silver jewelry are almost always made from gold and silver alloys. Compare pure gold and silver's physical properties to those of a few common alloys, such as sterling silver or white gold.

Art

* The Globe Theatre, built in 1599, served as the primary performance venue for Shakespeare’s plays. Investigate the design of the Globe and how props and costumes were used to enhance the productions.

The works of Shakespeare have been the source of inspiration for many non-literary and literary works of art. Investigate how plays such as *The Tempest, A Midsummer’s Night Dream, The Merchant of Venice*, and *Romeo and Juliet* have been interpreted in painting and sculpture.

Math

* Many geometrical shapes have mathematical significance and can be used symbolically, such as tesselations, fractals, and sequences. Try to use at least one mathematical pattern to add extra meaning to your prop.

**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 Macbeth’s crown, students could investigate the types of metal forming technologies available during the period in which the play is set. The functional and aesthetic design features such as the base can be directly linked to knowledge of geometry.

**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 |
| Graphing | Tessellations | Transformations |
|  | Systems of linear equations | Tessellations |
|  |  | Quadratic equations |

|  |  |  |
| --- | --- | --- |
| **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 |  |

|  |  |
| --- | --- |
| **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**

|  |  |
| --- | --- |
| **Chemistry** | **Physics** |
| Materials and material finishes | Forces on objects |
| Resistance to corrosion | Simple machines |
| Adhesives | Energy conservation |
| Interchangeable materials | Ergonomics |
| Makeup of molecules | Electronics systems |
| Chemical composition of recycled content | Micro-electronics |
| Strength and weight of materials | Electrical conductivity |
| Chemistry of phone accessory production | Radio waves |

**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 concepts for the actual dagger used in the play or for interpreting the three sisters.
* Use Autodesk® 123D Design software to develop a stage set for a production of Macbeth.

**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.