COURSE TITLE: **S.T.E.M.: 3D Design/Printing with TinkerCad**

WA CLOCK HRS: **30**
OREGON PDUs: **30**
PENNSYLVANIA ACT 48: **30**

NO. OF CREDITS: **3 QUARTER CREDITS**
[semester equivalent = 2.00 credits]

INSTRUCTOR: **Patrick Getchis**
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COURSE DESCRIPTION:
Are you wondering how to generate a STEM buzz in your classroom? Tinkercad is an amazingly easy-to-use, powerful program for creating 3D digital designs that are ready to be 3D printed. This 3D modeling program empowers students to design all kinds of things, from custom homes to Mayan statue replicas, to cell models and engineered 3D-printed fidget spinners.

While designing in 3D, learners will have opportunities to apply NGSS and Common Core standards in meaningful and fun ways. This course begins by training teachers on how to use Tinkercad through several example projects they can use directly in their classroom. The course will cover managing a virtual classroom, tracking student progress, and assigning projects online. While having access to a 3D printer is not required, the course will cover tips on how to manage print jobs and student workflow successfully. Teachers will develop their own 3D modeling projects based on what they learn throughout the course.

Lastly, all teachers will leave the course with best practice resources for teaching 3D design/printing, including; student-friendly project tutorial videos, premade word walls, and 3D modeling vocabulary games. Upon completion, teachers will be equipped to integrate 3D modeling in whatever capacity they prefer, from simple enrichment opportunities to long-term design projects.

This course is appropriate for teachers 3-9.

LEARNING OUTCOMES: Upon completion of this course, participants will have:

- Gained an understanding of how 3D modeling/design can help students better apply science and engineering concepts while using real-world math.
- Learned to design engaging engineering projects where students can create prototypes using 3d modeling/printing.
- Gained the skills needed to teach students foundational computer science skills applicable to future STEM career pathways.
- Developed an understanding of what 3D printers are capable of and how this technology can empower student voice and creativity in the classroom.

COURSE REQUIREMENTS:
Completion of all specified assignments is required for issuance of hours or credit. The Heritage Institute does not award partial credit.

The use of artificial intelligence is not permitted. Assignment responses found to be generated by AI will not be accepted.

HOURS EARNED:
Completing the basic assignments (Section A. Information Acquisition) for this course automatically earns participants their choice of CEUs (Continuing Education Units), Washington State Clock Hours, Oregon PDUs, or Pennsylvania ACT 48 Hours. The Heritage Institute offers CEUs and is an approved provider of Washington State Clock Hours, Oregon PDUs, and Pennsylvania ACT 48 Hours.

UNIVERSITY QUARTER CREDIT INFORMATION

REQUIREMENTS FOR UNIVERSITY QUARTER CREDIT
Continuing Education Quarter credits are awarded by Antioch University Seattle (AUS). AUS requires 75% or better for credit at the 400 level and 85% or better to issue credit at the 500 level. These criteria refer both to the amount and quality of work submitted.

1. Completion of Information Acquisition assignments 30%
2. Completion of Learning Application assignments 40%

3. Completion of Integration Paper assignment 30%

CREDIT/NO CREDIT (No Letter Grades or Numeric Equivalents on Transcripts)
Antioch University Seattle (AUS) Continuing Education Quarter credit is offered on a Credit/No Credit basis; neither letter grades nor numeric equivalents are on a transcript. 400 level credit is equal to a "C" or better, 500 level credit is equal to a "B" or better. This information is on the back of the transcript.

AUS Continuing Education quarter credits may or may not be accepted into degree programs. Prior to registering, determine with your district personnel, department head, or state education office the acceptability of these credits for your purpose.

ADDITIONAL COURSE INFORMATION

REQUIRED TEXT
There is no course text and all materials are available online.

None. All reading is online.

MATERIALS FEE
None.

ASSIGNMENTS REQUIRED FOR HOURS OR UNIVERSITY QUARTER CREDIT

A. INFORMATION ACQUISITION
Assignments done in a course forum will show responses from all educators who have or are taking the course independently. Feel free to read and respond to others' comments.
Group participants can only view and respond to their group members in the Forum.

Assignment #1: Introductions
Watch this introduction video about your instructor, Patrick Getchis. Describe your professional situation and why you are interested in this course.

https://www.youtube.com/embed/-o2I2vQR2V4

Assignment #2: Intro to Tinkercad
Watch: Tinkercad in the Classroom (watch until 18:00)

https://www.youtube.com/embed/63fAhwyyMKk
Write a 1 page reflection to the following questions:

- What is Tinkercad and how can it be used to help build STEM skills in the classroom?
- How do skills in 3d design relate to potential STEM career pathways?

Assignment #3: Getting Started with Tinkercad
Set up a teacher account on Tinkercad.com.

- Click on Resources, then Learning Center. This is a great place to find resources about how to begin designing with Tinkercad.
- Scroll down to the tutorial "Lets Learn Tinkercad". This is a great tutorial for initial training in 3D design using Tinkercad.
- Spend some time getting to know the controls and basic tools. As you complete all 5 lessons and I encourage you to "tinker" as you learn.

Write a one-page response to the following questions:

- Describe your learning experience throughout these lessons in a one-page reflection. Which processes were most intuitive?
- Which processes were most challenging?

Useful Resources: Tinkercad Word Wall, Tinkercad Kahoot Game.

Assignment #4: Exploring 3D Design Resources
Log in to Tinkercad, click Resources, then Learning Center. There are several student-friendly 3d design tutorials in the Learning Center.

- Explore the simple skill-building tutorials: Place it, View it, Move it, Hide It, Creating Holes, Align It, Copy It, Duplicate It.
- Spend some time exploring other tutorials in the Learning Center, Projects, and lesson plans within the Tinkercad platform.
- How could you use these tutorials for helping students learn 3d modeling in the classroom?

Write a one-page reflection.

Assignment #5: 3d Printing in Education

- Read/explore the following resources about 3D printing in the classroom.
  Write a 1-2 page reflection about the possible merits of having such a tool available to students.
  Resource 1, Resource 2, Resource 3, Resource 4 (3d model bank)
- Watch the following video about using Tinkercad and a 3D printer in the classroom.
  https://www.youtube.com/embed/tpfdz75CFpg

  At the bottom of your 1-2 page reflection, ask your instructor specific questions you have about 3d printing in the classroom.

Assignment #6: Managing Workflow in Tinkercad

- Watch Tinkercad in the Classroom. (Watch 19:33-25:10).

https://www.youtube.com/embed/63fAhwyyMKk

- Learn how to set up your classroom in Tinkercad.
- Read: Setting Up Tinkercad Classroom. Set up an example classroom in Tinkercad.

Write a 1/2 -1 page summary of how you plan on having students sign into Tinkercad

Assignment #7: Sample Project - Keychain Engineering
For this assignment, you will explore an example engineering design project using Tinkercad (3D Printer optional). Click on these video tutorials, complete the project, and answer the following reflection questions.

- Tutorial 1: After watching this video, make your keychain design sketches. Take a photo to include in your reflection.
  https://www.youtube.com/embed/Z4_9oLOiKmU
- Tutorial 2: Follow along with this tutorial and design a working keychain prototype. Here is a copy of the referenced lesson plan.
  https://www.youtube.com/embed/6S_uIfAcPIY
- Upload a picture of your final design.

Assignment #8: Sample Project: Fidget Spinner Engineering
In this assignment, you will engage in a more complex engineering project using 3d modeling/printing (3d printer optional). Click on these video tutorials, complete the project, and write a 1-2 page response to the following questions:

- Tutorial 1: After watching this video, make your fidget spinner design sketches. Take a photo to include in your reflection. Here is a copy of the referenced lesson plan.
  https://www.youtube.com/embed/w2zIi5e9kQ8
- Tutorial 2: Follow this tutorial and design a working fidget spinner. Take a screenshot to include in your reflection.

https://www.youtube.com/embed/F-XkpAUg134

Write a 1-2 page response to the following questions:

1. Reflect on your experience completing this example engineering activity as a student.
2. Explain how Tinkercad can be used to scaffold engineering design in the classroom.

Assignment #9: Sample Project: 3D Modeling in Science Class
In this assignment, you will learn how to use 3D modeling to demonstrate knowledge of a scientific concept.

- Read through this sample lesson plan.
- Build a model of either a plant or animal cell in Tinkercad.
- Write a 1-2 page reflection answering the following questions:

1. Upload a picture of your cell model, and explain how Tinkercad could be used to model a specific STEM concept.
2. Give an example of how you could use this idea to enhance a unit you teach.

ADDITIONAL ASSIGNMENTS REQUIRED FOR UNIVERSITY QUARTER CREDIT

B. LEARNING APPLICATION
In this section, you will apply your learning to your professional situation. This course assumes that most participants are classroom teachers who have access to students. If you do not have a classroom available to you, please contact the instructor for course modifications. Assignments done in a course forum will show responses from all educators who have or are taking the course independently. ?Feel free to read and respond to others' comments. Group participants can only view and respond to their group members in the Forum.

Assignment #10: Teaching Learners How to Use Tinkercad
Think back on all the resources presented in the Learning Acquisition section. Develop a short unit (2-3 lessons) on how you could teach 3D modeling/design techniques to kids. Use whatever lesson plan format serves your needs. The lesson plan should include:

- 3d modeling learning targets
- Describe how you will teach Tinkercad vocabulary so the language is accessible to learners.
- Feel free to use the game and vocabulary cards shared in this course.
- Explain how you ensure students gain basic skills in Tinkercad, whether it be through modeling with the whole group, screencasts, PowerPoint, or another learning avenue.
- Include how you will assess student understanding.

Assignment #11: Using Tinkercad to Model a Scientific Concept
In this assignment, you will design a project that uses 3d modeling to help students better understand a STEM concept. Some example topics could include molecules/compounds, habitat/niche, cells, landforms, and the layers of the earth. You may use whatever lesson plan format suits your teaching style. The unit should be designed so students have at least 3 hours of class time to develop designs and demonstrate their learning.

- Establish essential questions/learning targets
- Provide scaffolding necessary for students to access and use academic vocabulary throughout the unit.
- Describe how you will support the students throughout the modeling process. This could include but is not limited to, screencasts, written instructions, slide decks, or premade Tinkercad tutorials.
- Consider structuring the project so students can collaborate and provide feedback on designs.
- Provide your scoring rubric and how you will assess student growth/understanding.

Assignment #12: Using 3d Modeling in Engineering
In this assignment, you will design a project that uses 3d modeling to help facilitate the engineering design process. Design an

engineering project where students can use Tinkercad to solve a real-world problem. Feel free to use the Engineering Design Cycle from the learning acquisition section. The unit should be designed so the students have at least 3 hours of class time to develop designs and demonstrate their learning.

- Design a Project using the following guiding questions:
- Ask: How will you set the stage for asking the question/defining the criteria and constraints of the problem?
- Imagine: How might students brainstorm multiple ideas for solving the problem?
- Plan/Create: How will you scaffold the building process?
- Improve:

1. How will learners test their designs to make sure they meet the criteria constraints?
2. How might they get constructive feedback about their designs? (This can be done via modeling in Tinkercad or physical prototypes from the 3d printer)

- Provide your scoring rubric and how you will assess student growth/understanding.

Assignment #13: (500 Level ONLY)
In addition to the 400-level assignments, complete two (2) of the following:

Option A)
Make a resource document for 3D modeling that you can reference as you begin using Tinkercad/3D Printing in the classroom. For each resource, write a short description of why it's useful. This could include links to projects, lesson plans, and important articles related to scaffolding 3D design in the classroom.

AND/OR

Option B)
Research potential 3D printer models for your classroom. Develop a plan to present to your team, administrator, Ed. Foundation, or PTO, for funding such a tool. Write a 2-3 page paper outlining your plan and budget and illustrating the merits of 3D Printing in the classroom.

AND/OR

Option C)
Design your own assignment, applicable 3D Design/modeling, and your classroom needs. Please pitch your idea to the instructor for prior approval.

C. INTEGRATION PAPER
Assignment #14: (Required for 400 and 500 Level)

SELF REFLECTION & INTEGRATION PAPER
(Please do not write this paper until you've completed all of your other assignments)

Write a 400-500 word Integration Paper answering these 5 questions:

1. What did you learn vs. what you expected to learn from this course?
2. What aspects of the course were most helpful and why?
3. What further knowledge and skills in this general area do you feel you need?
4. How, when and where will you use what you have learned?
5. How and with what other school or community members might you share what you learned?

INSTRUCTOR COMMENTS ON YOUR WORK:
Instructors will comment on each assignment. If you do not hear from the instructor within a few days of posting your assignment, please get in touch with them immediately.

QUALIFICATIONS FOR TEACHING THIS COURSE:
Patrick Getchis, M.A. is a STEM teacher at Wy'east Middle School in Odell, Oregon. Over the past 17 years, Patrick has developed a passion for bringing real world, hands-on STEM education to a diverse group of students. Although he teaches in a humble, small town

agricultural setting, his classroom is equipped with 21st century tools and equipment for students to dream, design and build. As a young boy, Patrick spent countless hours designing contraptions in his father's workshop. From experimental pedal powered airplanes, to Huck Finn style rafts, he was an early adopter of the Maker Movement. Earlier in his career Getchis's students learned chemistry through designing a small-scale biodiesel reactor. He saw the enthusiasm in their eyes as they retrofitted a small diesel pickup and ran it on recycled vegetable oil. Patrick believes when learning is contextualized through meaningful experience, students will flourish. Since then, his classes have built campus farms to feed the food bank, engineered custom skateboards, designed drones, and fabricated custom ukuleles using state-of-the-art technologies such as laser cutters and 3d printers. Patrick is an avid robotics enthusiast and his students have won FLL state championships three times. His students love engineering wrestling robots, reinventing the Roomba vacuum, and designing solar cell phone chargers. He prides himself on finding inclusive, high interest project threads that naturally engage learners to apply science, technology, engineering and math. BA: Biology/Chemistry, Castleton University MAT: Secondary Science/Math, Lewis and Clark College

BIBLIOGRAPHY

S.T.E.M.: 3D Design/Printing with TinkerCad

EdTech Magazine: https://edtechmagazine.com/k12/

EdTech: Focus on K-12 explores technology and education issues that IT leaders and educators face when they're evaluating and implementing a solution. The magazine has published a fair amount about 3D design in the classroom. EdTech: Focus on K-12 is published by CDW, which is headquartered in Vernon Hills, Ill.

Make Magazine: www.makezine.com

Make is an American magazine published since June 2019 by Make: Community LLC which focuses on Do It Yourself and/or Do It With Others projects involving computers, electronics, metalworking, robotics, woodworking, and other disciplines. It hosts several project ideas as well as technical reviews on various software/hardware applicable to STEM classrooms.

Thingiverse: www.Thingiverse.com

Thingiverse is a website dedicated to the sharing of user-created digital design files. Providing primarily free, open-source hardware designs licensed under the GNU General Public License or Creative Commons licenses, the site allows contributors to select a user license type for the designs that they share.

Tinkercad: www.tinkercad.com

Tinkercad is a free-of-charge, online 3D modeling program that runs in a web browser. Since it became available in 2011 it has become a popular platform for creating models for 3D printing as well as an entry-level introduction to constructive solid geometry in schools. It is made by Autodesk and is the stepping stone to Fusion 360, one of the industry's top 3D modeling programs. The software also includes many K-12 teaching resources and sample projects to help educators model with students in the classroom.

Teq: www.Teq.com

Teq is an educational technology company that specializes in professional development in STEAM education. The company has compiled research for teachers regarding 3D modeling and printing in the classroom.