

COURSE TITLE: BRINGING ENGINEERING DESIGN & CODING INTO YOUR CLASSROOM (STEM)
WA CLOCK HRS: 60
OREGON PDUs: 60
PENNSYLVANIA ACT 48: 60

NO. OF CREDITS: 6 QUARTER CREDITS
[semester equivalent = 4.00 credits]

INSTRUCTOR: Dean Thomas
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COURSE DESCRIPTION:

Design Thinking is a critical skill needed for our students to be prepared to solve life skills they will encounter throughout life in any circumstances. Design Thinking is the non-linear iterative process in which to solve problems. The engineering design process includes the following:

- 1) Define the Problem
- 2) Research
- 3) Plan
- 4) Create
- 5) Test and
- 6) Improve.

Code.org and Scratch are two free online programs that teach students basic coding skills and allow them to create various projects of their choice, including games, animations, stories, and art.

Both programs use block coding, a form of programming that allows the user to create code without having to learn specific coding languages. This class is designed for the teacher interested in teaching coding but lacks a background in computer science. The course material is most appropriate for teaching grades 3 - 9, but it is also great for anyone who wants to learn basic coding for themselves. Upper-level high school teachers may find that the class helps create introductory lessons for higher-level coding classes.

Participants in this course will gain the background knowledge necessary to teach the engineering design process and basic coding activities. Through exploring informative websites and free online coding programs, teachers will engage in activities that can be used directly in their classrooms.

You will complete the class feeling confident in your ability to teach the curriculum and have lesson plans that are ready to go. There are no additional fees associated with this class.

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

- Understand the engineering design process and the importance of exposing design thinking to their students.
- Understand how to navigate code.org website, create classes linked from Google Classroom or alternative means, and monitor student progress in activities.
- Understand the basics of Scratch and create a coded project of their own to provide examples to the class.
- Have created an engineering design and coding unit that can be used in their 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%
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CREDIT/NO CREDIT (No Letter Grades or Numeric Equivalent 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

None.

None. All reading is online.

MATERIALS FEE

All materials online

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: Introduce Yourself

Briefly introduce yourself, including your professional situation. Describe your current understanding of the engineering design process and coding experience. Describe the outcomes that you would like to take away from the course.

Assignment #2: Coding is Not Just for Coders TED Talk Exploration

Ali Partovi, the creator of Code.org, makes several arguments as to why computer science should be taught in all schools. He argues that computer science is foundational. Two more TED Talks from teenagers provide support to his arguments.

Write a 425 - 500 word essay that addresses the following:

- Describe the main arguments as to why computer science is foundational to ALL students.
- Describe any takeaways that stood out to you.
- Explain your thoughts as a teacher. Do you agree or disagree with their points?

Review these videos from TED Talks:

- “Learning to Code is Not Just for Coders” | Ali Partovi
<https://www.youtube.com/embed/MvTSPwftvyo>
- Why introduce coding early in school education | Raunak Hede
<https://www.youtube.com/embed/G-sD4NU-nNs>
- Coding: By a kid, for kids | Krish Mehra
<https://www.youtube.com/embed/vOsdRBrNdk>

Assignment #3: Understanding the need for Diversity in STEM TED Talk Exploration

Picture an image in your head of an engineer, do you have it in your mind, how would you describe the image? If you are not familiar with studies around this question, you may be surprised by the results of the image typically described. The following videos discuss the need for diversity in our STEM workforce. Watch the following women describe their paths to engineering careers and the challenges they faced along the way.

Write a 600 - 700 word essay addressing the following questions:

- What are your major takeaways from the talks?
- Why is it important to have diversity in STEM?
- What are ways that you could promote and encourage your historically underrepresented students to explore STEM in your classroom?

Links to TED Talks (Choose at least three videos to watch):

- Teach girls bravery, not perfection | Reshma Saujani
<https://www.youtube.com/embed/fC9da6eqaqq>
- The Future of STEM Depends on Diversity | Nicole Cabrera Salazar
<https://www.youtube.com/embed/-v8aDo4dV3Q>
- The Superpowers of STEM | Stephanie Hill | TEDxMidAtlantic
<https://www.youtube.com/embed/vUaQNCEXxAc>
- Inspiring the next generation of female engineers | Debbie Sterling | TEDxPSU
<https://www.youtube.com/embed/FEeTLopLkEo>
- Indian Girls Code | Aditi Prasad | TEDxChennai
<https://www.youtube.com/embed/86O2khAeO5I>

Assignment #4: Engineering Design & NGSS

Read the following documents regarding engineering design and the Next Generation Science Standards to gain an understanding of the rationalization and importance of engineering design in our K-12 educational standards. In 600-700 words, explain the “why” of the standards and the progression of what is expected from students as they move from kindergarten to high school in regard to engineering design.

Readings:

- [APPENDIX I – Engineering Design in the NGSS](#)
- Use the following link to access the readings below. You will need to scroll down to select the Engineering Standards by topic. After reading the elementary standards, switch the tab to middle school and high school standards. [Access to the Next Generation Science Standards by Topic -NSTA \(main page\)](#)
- Grades K-2 Engineering Design Introduction
- K-2. Engineering Design
- Grades 3-5 Engineering Design Introduction
- 3-5. Engineering Design
- Middle School Engineering Design Introduction
- MS. Engineering Design
- High School Engineering Design Introduction
- HS. Engineering Design

Assignment #5: Exploring Engineering Online Resources

The internet provides teachers with so many possible lessons and activities that we can use to engage our students in engineering. This assignment provides the time for you to explore a few of these vast resources. Teachengineering.org is one that not only provides lessons but also provides more insight into the engineering design process and the “why” behind the importance of teaching

engineering to our students. Explore the following resources to gain insight. Find at least one resource for an activity that you could use in your classroom or pass on to a colleague in another related subject. to the large amount of curriculum that is out there. Find at least one resource for an activity that either you could use in your classroom or could pass on to a colleague in another related subject.

Write a short description of the activity and include links to the resources to share with other teachers in our class. Be sure to include the subject area and age appropriateness of the activity. Post your response on the Heritage forum.

Here are some links to explore:

- [Teachengineering.org](https://www.teachengineering.org)
- [NASA Jet Propulsion Laboratory](https://www.nasa.gov/jet-propulsion-laboratory)
- [Tryengineering.org](https://www.tryengineering.org)
- Search for other online resources

Assignment #6: Navigating Code.org & Coding Foundations

[Express Course 2022](#) is a great way for students to build a foundation for coding in a fun and engaging platform. Students will learn the basics of the following concepts: sequencing, events, loops, conditionals, functions, and variables.

- Create an account with code.org
- Use this link to access the [Express Course 2022](#)
- Create a new classroom section from the heading My Dashboard.
- Each coding concept is broken into different categories with 3 or more activities that focus on the particular skill. Each lesson is designed to be completed in about an hour for students. Please complete all 28 challenges of the Express Course 2022 (End of the Course Project-NOT required). Be sure to look over the lesson plans of each lesson for discussion questions and possible teachable moments in each lesson.
- Be sure to **Log in using your teacher account**. That way you can use the **See Solution** button if you get stuck on a challenge. Don't use it too quick though! :)
- For each concept (Sequencing, Sprites, Events, etc.), in one or two paragraphs, explain the concept and describe your experience with the code.org lessons. What were the takeaways or lessons learned that you would want to point out to students when they complete the activities?

Note: When teaching these concepts to my students, I require them to complete an assigned challenge and then allow them to choose another lesson of their choice within the category. It is a good way to give students autonomy and gives advanced students something to do while you focus on students who are struggling.

Assignment #7: Hello World/ Introducing Scratch

In this assignment, you are introduced to the online program Scratch. Scratch is a great platform that allows students to create programs of their own in the block coding environment. You will create your very own first program, "Hello World". It will show you the basics of how to create an account and begin programming on your own. Click on the [Intro to Scratch link](#) to watch a short instructional video and begin your journey.

<https://www.loom.com/embed/9a3e4c96689541f6857a4695933e17b2>

Complete the following steps for success:

- Open [Scratch](#)
- Create an account and confirm your account by replying to their email (Your account needs to be confirmed to be able to share your work).
- Create your program
- Be sure to add any relevant information in the Instructions and Notes/Credits boxes on the project page.
- Click the orange share button to create a sharable link to your project
- Click the blue Copy Link button
- Write one to two paragraphs describing your first experience in the world of Scratch. Be sure to include a link to your Hello World program.
- Share your link to your project in the Heritage forum.

Assignment #8: Animate Your name in Scratch

This assignment introduces you to the built-in tutorials within Scratch. Navigate to the Animate your Name tutorial in Scratch. Watch the tutorial and complete your own version of the project. You may choose to create your name, a word, or a phrase to complete the

assignment.

Complete the following steps for success:

- Create a new project in Scratch. (Note: Previously saved projects in Scratch can be found in the upper right-hand corner of the homepage under My Stuff).
- The tutorials can be found in the headings, or they can be found under Ideas as well.
- Click on the Animate Your Name tutorial (Be sure to click the green arrow in the tutorial to see each step of the particular tutorial. This is also a good reminder to mention to students because they often miss it.).
- Create your program.
- Be sure to add any relevant information in the Instructions and Notes/Credits boxes on the project page.
- Share your link to your project in the Heritage forum.

Assignment #9: Scratch Choice Project

It is time to show off your newly acquired coding skills! Scratch allows the user to create any type of project ranging from games, stories, and animations, to art. You can choose any type of project that most interests you. Take your project to whatever level you feel pushes your comfort level. Click on the Explore tab to see other types of projects that have been shared in Scratch. The ideas tab is a great place to look for tutorials that will lead you through the process. Google and YouTube are also great resources for tutorials.

Share the link to your project in the Heritage forum. Include a short narrative that describes your project as well as components that you are most proud of and struggles you overcame. Lastly, provide feedback on at least one other project posted in the forum.

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: Engineering Design Poster Project

It is important to explicitly teach the process of Design Thinking to students. Students often get caught up in wanting to memorize an exact vocabulary of the process. For example, the first step is defining the problem, which could be described using different vocabulary such as: Define Problem, Ask, or Empathize. The true importance is that they understand the process rather than memorize a set of words.

Having students create a poster allows them to demonstrate their understanding of the process rather than specific vocabulary.

Design a poster of the engineering design that you could use as an example in your classroom. You could create it digitally using Google Slides or an online program such as [Canva](#) or on paper. Upload the file or picture of your poster. A quick Google image search of the engineering design process will generate plenty of ideas.

Assignment #11: Main Ideas & Pitfalls

The point of this assignment is to prepare you for the remaining assignments. Create a bulleted list of concepts, main points, and possible pitfalls that you have taken away from the course so far that you know that you want to pass on to your students. You may think of more along the way, but the idea is to get your planning moving forward.

Assignment #12: Create an Assessment

Every teacher has their preferred method of how to go about creating a unit of instruction. Some teachers prefer backward planning, while others work in a linear fashion. You may choose to work on this assignment first or come back to it later. For this assignment, create an assessment that allows students to demonstrate their understanding of the material. You may choose any format that fits

your unit. This could be an actual quiz that you plan to give your students or a list of questions you plan to use as formative assessment, such as a warm-up question, discussion, or ticket out the door.

Assignment #13: Design Your Coding Unit

Review the Engineering Design standards for your appropriate grade level and create a unit that will teach the engineering design process and coding skills to your students. The length of this unit is up to you and depends on what you feel you have time to complete with your students. Feel free to use whatever template works best for you. If you are planning a long-term project (multiple weeks) with engineering and coding, a general scope and sequence outline with major concepts covered each day would be sufficient.

Assignment #14: Grading Rubrics

Grading rubrics not only provide consistency in grading student work, they also make it clear to both student and the teacher what is expected for the completed project. For this assignment, create grading rubrics for any projects you plan to include in your unit. Use any format for the rubric that works best for you and your students.

Assignment #15: Coding Slidedeck Presentation

This assignment is designed to prepare you for rolling out your curriculum to your students. The slides should cover all of the main concepts that you plan to teach and guide you through other points that you want to cover, such as possible pitfalls. The length of this assignment depends on how in-depth you plan to go with your coding unit. (A minimum of 8 slides.) Share your presentation on the Heritage forum.

Assignment #16: (500 Level ONLY)

In addition to the 400-level assignments, complete **two (2)** of the following:

Option A) PLC Presentation

Prepare a Presentation for an in-service for other PLC members on what you learned through this course. (A minimum of 8 slides and plus notes)

AND/OR

Option B) Cross-Curriculum Project

Work with another colleague to develop a cross-curriculum project. For example, stories or animations could explain a particular event in history or math trivia animations could focus on current math concepts. Write a 1200 - 1500 word paper describing your plan.

AND/OR

Option C) Research Paper

Identify three research studies related to STEM, Engineering, and/or Coding at either the elementary, middle or high school (select the grade level you are teaching or planning on teaching). Write a summary of each of the studies and determine how you would implement the ideas and strategies in your classroom teaching and planning. (Minimum of 1000 words)

AND/OR

Option D) Choice Assignment

Another assignment of your own design with the instructor's prior approval.

C. INTEGRATION PAPER

Assignment #17: (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?
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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:

Dean Thomas, M.S.T., received a Master's Degree in Science Teaching from Portland State University in 2010. He has spent over a decade teaching science in the middle school classroom near Portland, OR. During this period, he has been a teacher leader for his school district, designing and implementing NGSS based science curriculum. The last few years have provided him the opportunity to focus fully on hands-on engineering practices in a middle school engineering design elective program. As a Heritage Institute instructor, his goal is to create a curriculum for teachers that is not only informative but can be used directly back in their classrooms.

BIBLIOGRAPHY**BRINGING ENGINEERING DESIGN & CODING INTO YOUR CLASSROOM (STEM)**

Code.org - Express Course 2022

<https://studio.code.org/s/express-2022>

Great free online source to teach students how to code through Hour of Code lessons.

NASA Jet Propulsion Laboratory - Engineering in the Classroom

<https://www.jpl.nasa.gov/edu/teach/resources/engineering-in-the-classroom.php>

A good source for understanding NGSS and access to free lessons to use in your classroom.

National Science Teachers Association (NSTA). Accessing the Next Generation Science Standards

<https://ngss.nsta.org/AccessStandardsByTopic.aspx>

This site makes it simple to access our K-12 NGSS standards.

nextgenscience.org (2013. April). Appendix 1 Engineering Design in the NGSS. Retrieved from:

https://www.nextgenscience.org/sites/default/files/Appendix%20-%20Engineering%20Design%20in%20NGSS%20-%20FINAL_V2.pdf

Scratch

<https://scratch.mit.edu/>

A great free website from MIT that allows the user to create programs using block coding.

Teach Engineering

<https://www.teachengineering.org/>

Another great source for understanding Engineering Design and free curriculum to use in your classroom.

TED (2016, Mar. 28). Teach Girls Bravery, Not Perfection | Reshma Saujani [video] YouTube.

<https://www.youtube.com/watch?v=fC9da6eqaqq>

TEDx Talks (2013, Apr. 19). Inspiring the Next Generation of Female Engineers | Debbie Sterling [video] YouTube.

<https://www.youtube.com/watch?v=FEeTLopLkEo>

TEDx Talks (2015, Jun. 30) The Future of STEM Depends on Diversity | Nicole Cabrera Salazar [video] YouTube.

<https://www.youtube.com/watch?v=-v8aDo4dV3Q>

TEDx Talks (2016, Dec. 1). Learning to Code is Not Just for Coders | Ali Partovi [video] YouTube.

<https://www.youtube.com/watch?v=MvTSPwftvyo>

TEDx Talks (2017, Mar. 7). Coding: By a Kid, for Kids | Krish Mehra [video] YouTube. <https://www.youtube.com/watch?v=vOsdRbrNdk>

TEDx Talks (2018, Jul. 17). Indian Girls Code | Aditi Prasad [video] YouTube.

<https://www.youtube.com/watch?v=86O2khAeO5I>

TEDx Talks (2018, May 15). Why Introduce Coding Early in School Education | Raunak Hede [video] YouTube.

<https://www.youtube.com/watch?v=G-sD4NU-nNs>

TEDx Talks (2018, May 25). The Superpowers of STEM | Stephanie Hill [video] YouTube.

<https://www.youtube.com/watch?v=vUAQNCEXxAc>

TryEngineering

<https://tryengineering.org/>

TryEngineering provides teachers resources and lesson plans related to the field of engineering.