Course of Study:

7th-Grade STEM

Course of Study STEM - [APRIL 2023]
STEM Grade 7
Strand: Introduction to the Engineering Design Process and "Human Centered Design"

<table>
<tr>
<td>Learning Standard:
Nature of Science Grades 6-8 (source pg. 10)
Scientific Inquiry, Practice and Applications
- Apply knowledge of science content to real-world challenges.
- Develop descriptions, models, explanations and predictions.
- Design technological/engineering solutions
Ohio's Cognitive Demands for Science (pg. 13, table 2)
DESIGNING TECHNOLOGICAL AND ENGINEERING SOLUTIONS USING SCIENCE CONCEPTS

6-8.ST.2.b. Explain the positive and negative impact the use of technology can have on personal, professional and community relationships
6-8.ST.3.c. Analyze how technological innovations and inventions can have multiple applications, both intended and unintended.

6-8.DT.1.d. Explain how optimization is the process of making a product as fully functional and effective as possible.
6-8.DT.1.f. Give examples of how trade-offs must occur when optimizing a design in order to maintain design requirements.
6-8.DT.2.a. Apply a complete design process to solve an identified individual or community problem: research, develop, test, evaluate and present several possible solutions, and redesign to improve the solution.
6-8.DT.2.b. Describe how invention is a process of turning ideas and imagination into devices and systems
6-8.DT.2.c. Explain how innovation is the process of modifying an existing system or system element(s) to improve it
6-8.DT.2.d. Consider multiple factors, including criteria and constraints, (e.g., research, cost, time, materials, feedback, safety) to justify decisions when developing products and systems to solve problems.
6-8.DT.4.a. Examine the progression of a product to identify how the functional, aesthetic and creative elements were applied</td>
<td>How Taught?
- Students are walked through the Engineering Design Process Presentation

- Students complete the Student Note Sheet

- Design Thinking and Human Centered Design are modeled for students

- Students complete a practice application by interviewing a peer and designing a shoe for them</td>
</tr>
<tr>
<td>Materials:
Engineering Design Process Presentation

Student Note Sheet</td>
<td>How Assessed?
- Assessment of student note sheet
- Formative assessment during class discussions
- Application on future projects</td>
</tr>
</table>

	How Re-Taught? - Revisited as students apply the process to future projects

---

Strand: Prototype Engineering: Paper Jump Rope

Learning Standard: MS-ETS1-2 - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS-1-4 - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved 6-8.DT.1.d. Explain how optimization is the process of making a product as fully functional and effective as possible. 6-8.DT.1.f. Give examples of how trade-offs must occur when optimizing a design in order to maintain design requirements.	**How Taught?** Structural Engineering and Paper Jump Rope Engineering Paper Jump Rope Engineering Document
Materials: Structural Engineering and Paper Jump Rope Engineering Paper Jump Rope Engineering Document	**How Assessed?** - Observations of students' abilities to collaborate - Assessment and reflection on the success of a prototype design Paper Jump Rope Engineering Document
	How Re-Taught? - Students are redirected during the project based on formative assessments by the teacher

---

Strand: Air Powered Rockets

Course of Study STEM - [APRIL 2023]
STEM Grade 7

<table>
<tr>
<td>Learning Standard:
Nature of Science Grades 6-8 (source pg. 10)
- Design and conduct scientific investigations using appropriate safety techniques.
- Use appropriate mathematics, tools and techniques to gather data and information.
- Analyze and interpret data.

MS-ETS1-2 - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3 - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.</td>
<td>How Taught?
Rocket Slideshow

- Basic paper rocket design is modeled for students

https://blogs.nasa.gov/Rocketology/2015/07/09/designing-a-rocket-in-six-easy-steps/

DIY Rocket landing video</td>
</tr>
<tr>
<td rowspan="2">Materials:
Rocket Slideshow

https://blogs.nasa.gov/Rocketology/2015/07/09/designing-a-rocket-in-six-easy-steps/

DIY Rocket landing video</td>
<td>How Assessed?
- Accuracy of mass, length, and distance measurements

- Graph and analyze data from various rocket designs

- Draw conclusions of the ideal rocket design using data as evidence</td>
</tr>
<tr>
<td>How Re-Taught?
- Students are redirected during the project based on formative observations by the teacher</td>
</tr>
</table>

Course of Study STEM - [APRIL 2023]
STEM Grade 7
Strand: Writing a Claim and Evidence: Journal on the Importance of STEM

<table>
<tr><td>Learning Standard:
W.6.1 Write arguments to support claims with clear reasons and relevant evidence.
W.6.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</td><td>How Taught?
Journal #1 Required or Optional STEM class

- Students are shown the elective course list for 8th grade

- Students respond to the prompt in the Journal link</td></tr>
<tr><td rowspan="2">Materials:
Journal #1 Required or Optional STEM class</td><td>How Assessed?
Journal Rubric</td></tr>
<tr><td>How Re-Taught?
- Students are provided feedback, claim and evidence are re-addressed in future writing</td></tr>
</table>

Course of Study STEM - [APRIL 2023]
STEM Grade 7
Strand: Steps of the Scientific Inquiry Process

<table>
<tr>
<td>Learning Standard:
Nature of Science Grades 6-8
Scientific Inquiry, Practice and Applications
- Apply knowledge of science content to real-world challenges.
- Identify questions that can be answered through scientific investigations.
- Design and conduct scientific investigations using appropriate safety techniques.
- Analyze and interpret data.
- Think critically and logically to connect evidence and explanations.
- Communicate scientific procedures and explanations.

6.SP.1.d - Interpret Results: Draw logical conclusions from the data based on the original question

6.EE.9 - Represent and analyze quantitative relationships between dependent and independent variables.

6-8.ICT.3.a. Analyze and integrate textual, visual and quantitative information</td>
<td>How Taught?
- Walk student through the Scientific Inquiry presentation

- Through class discussion, students share how each step of the process could be applied</td>
</tr>
<tr>
<td rowspan="2">Materials:
Scientific Inquiry presentation</td>
<td>How Assessed?
- Class discussions

- Completion of guided notes</td>
</tr>
<tr>
<td>How Re-Taught?
- Revisited as students apply the process to future projects</td>
</tr>
</table>

Course of Study STEM - [APRIL 2023]
STEM Grade 7

Strand: Reaction Speed Experiment: Practice vs. Reaction Speed Time

<table>
<tr>
<td>Learning Standard:
Nature of Science Grades 6-8
Scientific Inquiry, Practice and Applications
- Apply knowledge of science content to real-world challenges.
- Identify questions that can be answered through scientific investigations.
- Design and conduct scientific investigations using appropriate safety techniques.
- Analyze and interpret data.
- Think critically and logically to connect evidence and explanations.
- Communicate scientific procedures and explanations.

6.SP.1.d - Interpret Results: Draw logical conclusions from the data based on the original question

6-8.ICT.3.a. Analyze and integrate textual, visual and quantitative information</td>
<td>How Taught?
Reaction Speed Experiment

Student experiment sheet

Group discussion - what were flaws in the experiment</td>
</tr>
<tr>
<td rowspan="2">Materials:
Reaction Speed Experiment

Student experiment sheet

Group discussion - what were flaws in the experiment</td>
<td>How Assessed?
Student experiment sheet</td>
</tr>
<tr>
<td>How Re-Taught?
- Students are redirected during the project based on formative observations by the teacher

- Re-addressed in future activities</td>
</tr>
</table>

Strand: 3D Design and Printing Using CAD

<table>
<tr>
<td>Learning Standard:
6.NS.5 - Understand that positive and negative numbers are used together to describe quantities having opposite directions or values, use positive and negative numbers to represent quantities in real-world contexts

6-8.ICT.3.c. Create artifacts using digital learning tools and resources to demonstrate knowledge

6-8.DT.2.d. Consider multiple factors, including criteria and constraints, (e.g., research, cost, time, materials, feedback, safety) to justify decisions when developing products and systems to solve problems.

Social Studies - 2. - The civilizations that developed in Greece and Rome had an enduring impact on later civilizations. This legacy includes governance and law, engineering and technology, art and architecture, as well as literature and history</td>
<td>How Taught?
- Students complete an in class tutorial led by the teacher
Presentation: Ancient Greece and Rome 3D Printing Architecture</td>
</tr>
<tr>
<td rowspan="2">Materials:
www.TinkerCad.com

Ancient Greece and Rome 3D Printing Architecture</td>
<td>How Assessed?
Assessment on slide 22</td>
</tr>
<tr>
<td>How Re-Taught?
- Students are provided feedback when their project is not able to be 3D printed, and are allowed to resubmit as many times as necessary</td>
</tr>
</table>

Strand: Planning a School Outdoor Space

<table>
<tr>
<td>Learning Standard:
6-8.DT.1.f. Give examples of how trade-offs must occur when optimizing a design in order to maintain design requirements.

6-8.ICT.1.b. Select and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.

6-8.ICT.4.b. Select and use a variety of media formats to communicate information to a target audience

6-8.DT.2.a. Apply a complete design process to solve an identified individual or community problem: research, develop, test, evaluate and present several possible solutions, and redesign to improve the solution.

6-8.DT.2.d. Consider multiple factors, including criteria and constraints, (e.g., research, cost, time, materials, feedback, safety) to justify decisions when developing products and systems to solve problems.

6-8.DT.4.b. Analyze environments or products that are examples of the application of the principles of universal or inclusive design.</td>
<td>How Taught?
School Outdoor Space Presentation and Requirements

Map of CMS Grounds</td>
</tr>
<tr>
<td rowspan="2">Materials:
School Outdoor Space Presentation and Requirements

Map of CMS Grounds</td>
<td>How Assessed?
School Outdoor Space Presentation and Requirements</td>
</tr>
<tr>
<td>How Re-Taught?
- Students are redirected during the project based on formative observations by the teacher</td>
</tr>
</table>

Strand: Mechanical Engineering, Motors, and Gears

Learning Standard:	**How Taught?**
MS-ETS1-1 - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-2 - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3 - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS-1-4 - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved 7.RP - Developing understanding of and applying proportional relationships 6-8.DT.1.d. Explain how optimization is the process of making a product as fully functional and effective as possible. 6-8.DT.1.f. Give examples of how trade-offs must occur when optimizing a design in order to maintain design requirements. 6-8.DT.2.a. Apply a complete design process to solve an identified individual or community problem: research, develop, test, evaluate and present several possible solutions, and redesign to improve the solution.	Intro to Mechanical Engineering and Electric Car Challenge presentation Student Notesheet Gear Generator website
Materials: Intro to Mechanical Engineering and Electric Car Challenge presentation How Torque Wins a Bike Race video Gear Generator website Gear Ratios in Action video	**How Assessed?** Student Notesheet Top speed race competition between groups Truck pull (maximum weight pulled) competition between groups
	How Re-Taught?

	- Students are redirected during the project based on formative observations by the teacher

---

Strand: STEM Career Research Project

Learning Standard: W.7.7 - Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation. SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points 6-8.ICT.2.a. Use advanced search techniques to locate needed information using digital learning tools and resources. 6-8.ICT.4.b. Select and use a variety of media formats to communicate information to a target audience	**How Taught?** **STEM Career Research Presentation and Instructions** Example Career Presentation
Materials: **STEM Career Research Presentation and Instructions** Engineering Life Sciences Physical Sciences Math and Computer Science Health Sciences Technical and Trade Schools in Ohio US Army US Air Force	**How Assessed?** Example Career Presentation **STEM Career Research Presentation and Instructions** **How Re-Taught?** - Students are redirected during the project based on formative observations by the teacher

US Navy Example Career Presentation	

Course of Study STEM - [APRIL 2023]
STEM Grade 7
Strand: Bracket Challenge: The Most Important Branch of Engineering

Learning Standard: W.7.7 - Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation. SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points 6-8.ICT.2.a. Use advanced search techniques to locate needed information using digital learning tools and resources. 6-8.ICT.3.a. Analyze and integrate textual, visual and quantitative information (e.g., images, diagrams, maps, graphs, infographics, videos, animations, interactives) from multiple digital learning tools and resources. 6-8.ST.2.b. Explain the positive and negative impact the use of technology can have on personal, professional and community relationships 6-8.ST.3.c. Analyze how technological innovations and inventions can have multiple applications, both intended and unintended.	**How Taught?** **Presentation and Topic Choices**
Materials: **Presentation and Topic Choices** Presentation Scoresheet	**How Assessed?** Presentation Scoresheet **How Re-Taught?** - Students are redirected during the project based on formative observations by the teacher

Course of Study STEM - [APRIL 2023]
STEM Grade 7

Strand: Civil Engineering and Balsa Wood Bridge Competition

<table>
<tr>
<td>Learning Standard:
Ohio Science Standards Grade 7: Nature of Science Grades 6-8 (source pg. 10)
Scientific Inquiry, Practice and Applications
- Apply knowledge of science content to real-world challenges.
- Use appropriate mathematics, tools and techniques to gather data and information.
- Design technological/engineering solutions
MS-ETS1-1 - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2 - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

7.G.2 - Draw (freehand, with ruler and protractor, and with technology) geometric figures with given conditions

6-8.DT.2.d. Consider multiple factors, including criteria and constraints, (e.g., research, cost, time, materials, feedback, safety) to justify decisions when developing products and systems to solve problems</td>
<td>How Taught?

Civil Engineering and Bridge Design Presentation

Bridge Competition Requirements</td>
</tr>
<tr>
<td rowspan="2">Materials:
Civil Engineering and Bridge Design Presentation

Bridge Competition Requirements

Science Max Pasta Bridge Video

Earthquake Proof Bridge Video</td>
<td>How Assessed?
- Student created blueprints

- Self assessment of final design

- Calculation of bridge efficiency after testing

- Bridge Competition Requirements</td>
</tr>
<tr>
<td>How Re-Taught?
- Teacher led modifications to bridge blue-prints before students begin to build
- Assessment of student bridges after testing (breaking)</td>
</tr>
</table>

Strand: Financial Spreadsheet Applications: Stock Market Investing

<table>
<tr>
<td>Learning Standard:
Ohio Financial Literacy Standards: Middle Grades:
15. Using key investing principles one can achieve the goal of increasing net worth.
16. Investment strategies must take several factors into consideration such as compounding interest, costs, fees, tax implications and the time value of money.

6-8.ICT.1.b. Select and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.
6-8.ICT.2.a. Use advanced search techniques to locate needed information using digital learning tools and resources.
6-8.ICT.3.a. Analyze and integrate textual, visual and quantitative information (e.g., images, diagrams, maps, graphs, infographics, videos, animations, interactives) from multiple digital learning tools and resources.</td>
<td>How Taught?
Introduction to the Stock Market presentation

Teacher stock market spreadsheet example</td>
</tr>
<tr>
<td rowspan="2">Materials:
Introduction to the Stock Market presentation

Teacher stock market spreadsheet example</td>
<td>How Assessed?
- Student created spreadsheet to track investments over time

- Student updates of spreadsheet

- Student reflection on performance of investments</td>
</tr>
<tr>
<td>How Re-Taught?
- Students are guided through corrections on spreadsheet after the first stock price update</td>
</tr>
</table>

Strand: Introduction to Architecture and 3D Modeling of Buildings

<table>
<tr>
<td>Learning Standard:
MS-ETS1-1 - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2 - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS-1-4 - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved

7th grade math standards:
7.RP - Developing understanding of and applying proportional relationships

<u>Ohio Learning Standards - Technology Grade 6-8:</u>
6-8.ICT.1.b. Select and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.
6-8.ICT.3.c. Create artifacts using digital learning tools and resources to demonstrate knowledge.
6-8.DT.4.a. Examine the progression of a product to identify how the functional, aesthetic and creative elements were applied.
6-8.DT.4.c. Apply the design principle “form follows function” to develop a product</td>
<td>How Taught?
Introduction to Architecture and SketchUp presentation

Student note sheet

Students create a sample house following teacher created tutorial videos

Students select a client from the Home Design Client List to create a structure for in Sketchup</td>
</tr>
<tr>
<td rowspan="2">Materials:
Introduction to Architecture and SketchUp presentation

Student note sheet

Teacher created tutorial videos

SketchUp for Schools</td>
<td>How Assessed?
- Student completion of Student note sheet

- Structure design assessment found on last slide of Home Design Client List</td>
</tr>
<tr>
<td>How Re-Taught?
- Students are redirected during the project based on formative observations by the teacher</td>
</tr>
</table>

Home Design Client List	