ODCTE STEM Education Definition

Oklahoma Department of Career and Technology Education defines STEM education as an interdisciplinary approach to learning where rigorous academic concepts are combined with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that foster curiosity, critical thinking, problem solving, creativity, collaboration and communication. ODCTE-STEM makes connections between school, community, and the global workforce to enable the development of STEM literacy and the ability to compete in a new and ever changing economy.

Criteria for MS STEM Lessons (adapted from Anne Jolly, http://www.middleweb.com/20054/stem-2015-losing-focus/)

1. Focus on integrating science, technology, engineering – preferably all four, although true integration of even two would be an acceptable step toward STEM.
2. Focus on a real-world problem or engineering challenge.
3. Use Inquiry-based, student-centered learning approaches.
4. Engage students in using an *engineering* design process that leads to developing a product or process to solve the engineering challenge.
5. Builds a mindset of continual improvement and redesign
6. Provides students with a risk-free atmosphere in which to make mistakes and try again
7. Emphasize teamwork and communication.
8. Build rich content knowledge of science and mathematics.

Is my lesson a STEM lesson?(adapted from Anne Jolly, http://www.middleweb.com/20381/2-lessons-stem-or-not-stem/)

1. Lessons involve science AND mathematics-- Note, however, that STEM lessons don't necessarily teach the specific content in math and science – they may apply content that has already been taught. The key point is whether a STEM program applies math and science concepts to solve an engineering challenge and provide students with opportunities to integrate learning.

2. Lessons involve teamwork

3. Lessons involve a student-centered, inquiry based, hands-on approach.-- Do students get to explore and come up with ideas on their own, without being spoon-fed?

4. Lessons focus on a real-world problem.

5. Lessons involve collecting and analyzing data

6. Lessons use the engineering design process-- Allows team members to work together to design a solution and permits multiple possible solutions. Teams experiment and use research to choose a design to test

STEM Content:(http://www.middleweb.com/17912/makes-something-stem/)

- How was math integrated and applied?
- How was science integrated and applied?
- How was technology integrated (or created)?
- How was the Engineering Design Process used?

In STEM classes, students learn to:

• Ask good questions
• Understand issues at a deep level
• Drill down into problems
• Come up with innovative ideas and solutions
• Evaluate the results of their decisions
• Take charge of their own learning
• Engage in real teamwork
• Communicate effectively.

Questions to Answer About Students: (http://www.middleweb.com/17912/makes-something-stem/)

- How successfully were students able to engage in team problem-solving?
- Were they comfortable viewing failure as okay, and as a next step in a search for an answer?
- To what extent did students consider multiple right ways to approach and solve the problem?
- Did student teams develop and test a prototype for solving the problem?

STEM teachers

- Engage students in practices such as creative thinking, analysis, well-developed questioning, and generating multiple solutions for problems.
- Point out that out that these are practices associated with STEM.
- Help students make explicit connections among their regular lessons and their STEM learning. They are learning a thinking process – not isolated bits of information.

Duty A: Demonstrate Understanding of the Design Process	
A.01	Describe and apply the design process to solve a real world problem
A.02	Define the criteria and constraints of a design problem
A.03	Generate concepts and brainstorm while documenting research
A.04	Evaluate possible design solutions to identify the one that best meets the design criteria and constraints
A.05	Use appropriate tools or equipment to construct a model or prototype of the solution
A.06	Test prototype by collecting and analyzing data
A.07	Redesign to optimize solution.
Duty B: Demonstrate Understanding of Science Skills	
B.01	MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
B.02	MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
B.03	MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object
B.04	MS-PS3-2 Develop a model to describe when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
B.05	MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
B.06	MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
B.07	MS-PS3-6 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
B.08	MS-PS2-1 Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
B.09	MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. (simple machines)
B.10	MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.
Duty C: Demonstrate Mathematical Skills	
C.01	5.GM.3.2 Choose an appropriate instrument and measure the length of an object to the nearest whole centimeter or 1/16—inch.
C.02	6.GM.1 Calculate area of squares, parallelograms, and triangles to solve real-world and mathematical problems.
C.03	6.GM.3 Choose appropriate units of measurement and use ratios to convert within measurement systems to solve real-world and mathematical problems.
C.04	6.N.3 Understand the concept of ratio and its relationship to fractions and percents and to the multiplication and division of whole numbers. Use ratios to solve real-world and mathematical problems.
C.05	6.N.4 Multiply and divide decimals, fractions, and mixed numbers; solve real-world and mathematical problems with rational numbers.
C.06	7.D.1.2 Use reasoning with proportions to display and interpret data in circle graphs(pie charts) and

	histograms. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology.
Duty D: Demonstrate Communication of STEM topics	
D.01	Choose appropriate methods to communicate ideas
D.02	Use appropriate STEM vocabulary
D.03	Create and present effective oral presentation including a visual aid related to course topic
D.04	Compose a STEM journal or engineering notebook
D.05	Support all claims with evidence
Duty E: Prepare for a Career in Science, Technology, Engineering and Mathematics (STEM)	
E.01	Complete a career interest inventory
E.02	Investigate careers indicated in the career interest inventory
E.03	Develop an education plan for careers of interest
Duty F: Demonstrate 21st Century Skills	
F.01	Demonstrate effective team working skills
F.02	Demonstrate the ability to effectively collaborate and communicate with peers
F.03	Demonstrate effective organization management skills
F.04	Demonstrate effective time management skills
F.05	Incorporate an understanding of global economic awareness into projects and activities
F.06	Demonstrate leadership skills while formulating and planning group activities
F.07	Use computer/software skills to access, collect, and assess data
Duty G: Demonstrate Safety in the Classroom	
G.01	Identify tools and equipment used in the STEM program
G.02	Recognize potential hazards when working with classroom equipment, tools and supplies
G.03	Demonstrate safe and correct operating procedures when using equipment, tools and supplies (**NOTE:** Students must score 100% accuracy on safety evaluations when using equipment, tools and supplies)