**The Engineering Design Process** (Speakers: Ms. Brandi Foster, CEEMS Teacher; Mr. Jack Broering, CEEMS Resource Person; and Dr. David Vernot, CEEMS Resource Person; June 16, 2015, 1:00 pm–4:00 pm)

Ms. Brandi Foster began teaching in 2001 at Walbrook Uniform Services Academy #411 in Baltimore, Maryland, where she became the Special Programs Coordinator. She transferred to Cincinnati Public Schools in 2013 and started teaching at Aiken New Tech. Brandi currently is a PIE coordinator for Aiken New Tech and a GE Jr Scholars facilitator. She is currently a teacher in the Cincinnati Engineering Enhanced Math and Science (CEEMS) program at the UC, funded by a grant from the National Science Foundation.

Mr. Jack Broering currently serves as a member of the UC's CEEMS Resource Team. He earned a Bachelor of Science degree in Chemical Engineering from the University of Dayton and an Associate’s Degree in Electronics from Central Ohio Technical College. He is a retired engineer, having worked for The Dow Chemical Company for 33 years as a process improvement engineer. In addition to his current work on the Resource Team he develops and teaches computer classes and also serves as a mentor for students in the Green Learning program for the Civic Garden Center in Cincinnati.

Dr David Vernot has been a dedicated educator for 40 years. He currently is consulting with Butler County ESC, the UC CEEMS Project and the Ohio Department of Education. Recently, he retired from Fairfield City Schools with over 30 years of experience in the classroom and additional experience with curriculum and instruction, and assessment.

The presentation began with an introduction by Dr. Vernot. He asked participants to share their own levels of knowledge and experience with the engineering design process using red, yellow, and green cards that were distributed to everyone. Participants broke into small groups right away to share personal experiences of using projects and the engineering design process in their own classrooms.

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| **Figure 1: Brandi Foster and Jack Broering Presenting Workshop** | **Figure 2: RET Teachers Participate in Workshop** |

The learning objectives for the professional development session were clearly articulated as follows:

* Understand what the engineering design process is
* Be able to identify what happens in each step of the engineering design process
* View examples of the engineering design process in the classroom
* Know how the engineering design process is used in the “real world”
* Be able to access prior year CEEMS units with the database

Ms. Foster presented and explained the stages of the engineering design process.

* Identify and Define - Understand the scope of the challenge, and be able to restate it in your own words.
* Gather Information - Research unknowns and find information necessary to begin brainstorming solutions.
* Identify Alternatives - Brainstorm multiple solutions pathways with a team.
* Select Solutions - Pick one of the alternatives to pursue first.
* Implement Solution - Produce or implement selected product or process.
* Evaluate Solution - Check the solution against the original criteria and identify shortcomings.
* Refine - Seek ways to correct shortcomings of the original design within the parameters of the challenge.
* Communicate Solution - Share out the solution to the challenge in a designated time frame.

To give all participants personal experience with the engineering design process, Ms. Foster shared with the group one engineering based challenge called “Hit the Target”, and participants broke into groups and engaged in all the stages of the engineering design process to accomplish the given task. After participants engaged in the process themselves, there was a group debriefing to clarify any confusion about the steps of the process. At this juncture, Ms. Foster highlighted the importance of instilling these routines in students from the beginning of the year, and of giving students small formative checks along the way to make sure they’re on the right track. Mr. Broering followed this up with a summary video about using the engineering design process in the classroom.

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| **Figure 3: CEEMS Teachers Design Trebuchet** | **Figure 4: RET Teachers Design and Test Trebuchet** |
| **Figure 5: Amanda Sopko Tests Trebuchet** |

Dr. Vernot then walked participants through a variety of math and science based engineering design challenges for a variety of grade levels, explaining each thoroughly along the way. Through examples, Mr. Vernot demonstrated how a challenge could be science or math based, depending on the slant of the teacher. Mr. Vernot also emphasized the wide variety of end-points the challenges could have; “final products” for the various challenges ranged from constructed materials to a demonstrated process, to a model or equation, and beyond. Mr. Vernot emphasized that students don’t always have to build something as the result of the engineering design process.

Mr. Broering showed a video he created to demonstrate how engineers use the engineering design process in their daily work lives. The video featured Mr. Ted Verst, a structural engineer for a local Cincinnati design firm. Mr. Verst walked through the design process for one project and explained how various parts of the project aligned with the engineering design process. The video did a nice job of demonstrating how the theory of the engineering design process gets applied by engineers in their daily activities. It also demonstrated how the steps of the engineering design process are organic, and don’t necessarily follow a linear progression. Mr. Verst highlighted the need for regular communication between stakeholders and the importance of redesign and refinement throughout the process.

Finally, Mr. Vernot demonstrated how to access and use the CEEMS unit index. Mr. Vernot had all the participants access and download the index, and then encouraged participants to test out the various filters and look at some of the units that are available on the index.

In summary, this professional development session met all of its learning objectives and did a good job of getting participants involved in the engineering design process. It was helpful to have first-hand experience of the engineering design process through the project that participants did; it was also helpful to hear Mr. Verst explain how an engineer uses the engineering design process every day.