ESC Evaluation Services Center

Key Evaluation Results of the CEEMS Project, Year 6

Prepared for

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July 26, 2017

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Key Evaluation Results of the CEEMS Project
Year 6

Evaluation Services Center

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Suggested Citation

Morrison, A. B., Friedman, R., Wiechman, S., Maltbie, C. V., & Dariotis, J. K. (2017). *Key Evaluation Results of the CEEMS Project, Year 6*. Cincinnati, Ohio: Evaluation Services Center, University of Cincinnati.

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Key Evaluation Results of the CEEMS Project, Year 6

The CEEMS Evaluation has been guided by three primary evaluation questions that map to the project goals. To promote ease in reading, key data and results associated with the project are presented in a concise format with the following headings: Project Goals and Evaluation Questions, Evaluation Instrument/Metric, and Results and Outcomes.

Project Description

The current CEEMS evaluation results for the sixth project year, Academic Year 2016-2017, are summarized below by project goal. Overall, the CEEMS project is progressing toward attainment of these goals. Student interest in engineering is increasing, students are learning the engineering design process, and their content knowledge gains are increasing. Teachers are using CEEMS-promoted instructional practices and their usage is increasing the longer they remain in the program and has remained steady for up to two years after participation. Below are listed the Project Goals of interest for this summary.

1. Project Goal 1. Increase Grade 6-12 student knowledge of engineering design process and STEM careers and increase interest in college study in engineering or other STEM careers.
    a. Evaluation Question 1a. To what extent have students demonstrated knowledge of the engineering design process?
    b. Evaluation Question 1b. To what extent have students demonstrated interest in STEM-based fields and careers?
2. Project Goal 2. Increase Grade 6-12 student knowledge of math and science content when taught using engineering as a context for learning.
    a. Evaluation Question 2. To what extent do student math and science content scores increase as a result of unit implementation?
3. Project Goal 3. Develop math and science teacher knowledge of challenge-based learning, engineering, and the engineering design process as instructional strategies through explicit training and classroom implementation support.
    a. Evaluation Question 3a. To what extent and in what ways has teachers' knowledge increased in 1) CBL and 2) EDP?
    b. Evaluation Question 3b. What CEEMS project activities supported these changes?

Evaluation Results

For project goal 1, the majority of students reported that they learned about the engineering design process (EDP) and had an increased interest in engineering following unit implementation. A student STEM Interest survey (pre-post design) was added in Year 5. Both Cohort 4 and 5, together and separately, showed increases from pre to post in student STEM interest, particularly when asked about STEM careers. Three constructs were assessed on the Student STEM Interest survey. Students had increases in items relating to engineering, 21st Century Skills, and interest in three of the four career areas (increases for careers in science, technology, and engineering; decrease for career in math). There were decreases related to the importance of learning science and math. This may be a byproduct of the CEEMS focus on the engineering design process, teacher discussions of STEM careers, and using engineering principles in the classroom. Teachers also reported (100% strongly agreed or agreed) they saw classroom engagement increase compared to when non-CEEMS units were taught.

For project goal 2, teachers created pre-post assessments for each unit to show content knowledge gains. For 29 CEEMS teachers who reported pre- and post-assessment scores that could be matched, post-assessment scores increased 35.9% using a two-tailed paired t-test at a 95% CI. Sixteen (16) comparison teachers participated by assessing their students using the same pre-post assessment designed by the CEEMS teacher for their students who were learning comparable material but were not using CEEMS units. When comparing results between CEEMS and non-CEEMS units, CEEMS teachers' students scored a significantly higher mean difference of 4.1% than students in comparison teachers' classrooms using ANOVA at a 95% CI. As seen in previous years, these content gain results were corroborated by teachers, 89.2% of whom reported their students mastered the expected content, via surveys and focus groups, and students, via surveys, where 90.2% of students strongly agreed or agreed that they learned from these units.

For project goal 3, changes in teachers' self-reported current instructional practices indicate that <u>all</u> teachers are using the instructional practices promoted by the CEEMS training. The survey items comprise three constructs: CBL practices, practices related to guiding students through the process, and practices that provide students with opportunities related to these processes. Usage of all constructs increased significantly from pre- to mid-project, pre- to post-project, and pre- to first post-year follow-up. Some significant increases are also beginning to be seen in pre to second post-year follow-up (n=6). For confidence constructs, several significant increases were seen from mid to post; as expected, with more training and experience, a continued increase was seen between first and second year in teacher confidence (mid to post). The Current Instructional Practices constructs are detailed in Appendix A, along with alphas.

Teachers reported they were well trained, and 100% of teachers in Cohorts 4 and 5 agreed or strongly agreed that they had enough understanding of both CBL and the EDP process to effectively guide their students. Consistent with results from past years, teachers (97.1%) also reported the resource team was their most helpful support. All open-ended comments from the Teacher Post Unit Surveys are reported in Appendix B.

Table 1. CEEMS PROJECT YEAR 6 (2016-17) - Evaluation Instruments/Metrics and Teacher and Student Results and Outcomes

<table>
<tr><td colspan="2">Project Goal 1. Increase 6-12 student knowledge of engineering design process and STEM careers and increase interest in college study in engineering or other STEM careers.

Evaluation Question 1a. To what extent have students demonstrated knowledge of the engineering design process?

Evaluation Question 1b. To what extent have students demonstrated interest in STEM-based fields and careers?</td></tr>
<tr><td><u>Evaluation Instrument/Metric</u></td><td><u>Results and Outcomes</u></td></tr>
<tr><td><u>Student Feedback Survey</u>

Using CEEMS teacher input and piloting with students, this survey was adapted from the NSF ITEST CincySTEM Urban Initiative project (Grant #0929557) high school student survey.

“I understand how the EDP activity allowed us to solve to use the guiding questions to solve the challenge selected.”

“This unit made me more interested in engineering.”

“I learned about the careers related to this challenge and our solution.”

(Scale: 4=strongly agree, 3=agree, 2=disagree, 1=strongly disagree)</td><td><u>Student Feedback Survey</u>

• 84.5% of students agreed or strongly agreed that they understood how the EDP activity helped them solve the challenge. (n=3043, mean=3.13, SD=0.703)

• 59.8% of students agreed or strongly agreed that the unit increased their interest in engineering. (n=3024, mean=2.75, SD=0.927)

• 67.9% of the students agreed or strongly agreed that they learned about careers related to the challenge. (n=3034, mean=2.84, SD=0.831)</td></tr>
</table>

Project Goal 1. Increase 6-12 student knowledge of engineering design process and STEM careers and increase interest in college study in engineering or other STEM careers.

Evaluation Question 1a. To what extent have students demonstrated knowledge of the engineering design process?

Evaluation Question 1b. To what extent have students demonstrated interest in STEM-based fields and careers?

Evaluation Instrument/Metric	**Results and Outcomes**
Student STEM Interest Survey *This instrument was adapted from the REESE Student STEM Perceptions Survey, developed with NSF funding through the Center for Elementary Mathematics and Science Education (CEMSE) at the University of Chicago in collaboration with the Battelle Center for Mathematics and Science Education Policy at the Ohio State University and the Ohio STEM Learning Network (OSLN) and adapted with permission. This instrument is used to measure students' motivations towards entering STEM careers as well as their beliefs about their own aptitudes within the STEM areas, including their use of engineering design principles. Student participants complete this survey as a pre/post measure. The pre- measure is given at the start of the academic year in the class of a CEEMS participant. The post- is given at the conclusion of the same academic year.* This survey was written with embedded constructs. Since this is the first time we are using this instrument, we measured the reliability of these constructs and found four that have acceptable reliability: Interest in STEM Careers (alpha=0.725), Confidence in STEM Skills and Subjects (alpha=0.724), Confidence in and Importance of Learning STEM (0.742), and Confidence in 21st Century Skills (alpha=0.682.he analysis will include the individual questions that were significant from pre to post CEEMS units using an independent samples t-test within these constructs.	Student STEM Interest (Table A) • There were five items related to the self-reported importance and confidence students had in learning STEM that were significant from pre to post CEEMS Units. There was a negative change from pre to post CEEMS units for science, while there was a positive change for the math items and engineering design item. The two items with an asterisk (*) are also in the Confidence in STEM Skills and Subjects construct. These items are shown in yellow in Table A. • Self-reported student interest in all STEM related careers increased from before CEEMS Units to after CEEMS Units for careers in science, technology, and engineering, but math career had a negative change. These items are shown in green in Table A. • The last two items were found to be significantly different from before CEEMS units to after CEEMS Units, but were not part of a construct with an acceptable reliability.

Table A. Student STEM Interest

Item	Mean Difference (Post-Pre)	Std. Error Difference	t	df	Sig. (2-tailed)
It is important for me to learn science.	-0.085	0.025	-3.426	4088	0.001
It is important for me to learn how to design things.	0.137	0.030	4.521	4071	0.000
It is important for me to learn math.	0.069	0.024	-2.920	4060	0.004
I am confident I can learn science.*	-0.077	0.024	-3.170	3991	0.002
I am confident I can learn math.*	0.063	0.027	-2.327	4042	0.020
I am interested in a career in science.	0.179	0.039	4.642	4025	0.000

Project Goal 1. Increase 6-12 student knowledge of engineering design process and STEM careers and increase interest in college study in engineering or other STEM careers.

Evaluation Question 1a. To what extent have students demonstrated knowledge of the engineering design process?

Evaluation Question 1b. To what extent have students demonstrated interest in STEM-based fields and careers?

Evaluation Instrument/Metric	Results and Outcomes
(Scale: 5=strongly agree, 4=agree, 3=neither agree nor disagree, 2=disagree, 1=strongly disagree)	

I am interested in a career in technology.	0.184	0.037	4.694	4066	0.000
I am interested in a career in engineering.	0.237	0.039	6.091	4064	0.000
I am interested in a career in math.	-0.240	0.039	6.073	4044	0.000
Science is useful for solving everyday problems	0.078	0.028	2.814	4089	0.005
Math is applied in our everyday lives.	0.030	0.025	-2.866	4057	0.004

Key

Confidence in and Importance of Learning STEM
STEM Careers
No construct specified

Project Goal 1. Increase 6-12 student knowledge of engineering design process and STEM careers and increase interest in college study in engineering or other STEM careers. *Evaluation Question 1a. To what extent have students demonstrated knowledge of the engineering design process?* *Evaluation Question 1b. To what extent have students demonstrated interest in STEM-based fields and careers?*	
Evaluation Instrument/Metric	**Results and Outcomes**
Teacher Post Unit Survey: *Three surveys were jointly developed by the evaluation and project teams and piloted among four teachers to document important aspects of CEEMS units (CBL, EDP, and student outcomes as reported by teachers) that were successful and inform future modifications.* "Overall engagement of my students increased during this unit compared to non-CBL units." (Scale: 4=strongly agree, 3=agree, 2=disagree, 1=strongly disagree)	Teacher Post Unit Survey: • 100.0% of teachers were in agreement (*agreed* or strongly *agreed*) that their students' classroom engagement had increased during the unit compared to non-CBL units (n=74, mean=3.55, SD=0.500). • No differences by Teacher Cohort • Teacher quotes: o *"They were given a real-world situation that they have the power to help solve. They saw relevance big time!"* o *"My students loved this unit. They were incredibly engaged the entire time and they developed a great understanding of the EDP."*

Project Goal 2. Increase 6-12 student knowledge of math and science content when taught using engineering as a context for learning.

Evaluation Question 2. To what extent do student math and science content scores increase as a result of unit implementation?

Evaluation Instrument/Metric	**Results and Outcomes**
Student pre-post assessments of learning *Each teacher created unit-specific pre-post assessments of students' change in math and science content knowledge associated with the unit.*	Student pre-post assessments of learning • A total of 29 CEEMS teachers and 16 comparison teachers returned pre/post assessment scores for their students. • For all CEEMS Teachers: Students' scores increased 35.9% from pre- to post-test, measuring math and science content, for combined Cohort 4 and 5 teachers (n=3675). There is a significant difference in student gain scores at a 95% CI ($t_{(3675)}$=87.92, p<0.001). • Each CEEMS cohort also showed significant differences in score gains from pre to post: At a 95% CI ($F_{(1,3674)}$=24.95, p<0.001), Cohort 4 students' scores increased 34.6% from pre to post (n=2395) and Cohort 5 students' scores increased 39.0% from pre to post (n=1280). • For CEEMS vs comparison teachers: CEEMS teachers' students showed a higher mean difference in knowledge gain of 4.1% on the post-test than comparison teachers' students (CEEMS teachers' student scores: n=3675 (70% of total pairs); comparison teachers' student scores: n=1565 (30% of total pairs)). There was a significant difference on post-tests between CEEMS teachers and comparison teachers at a 95% CI ($F_{(1,5238)}$=26.78, p<0.001).
Student Feedback Survey "I learned a lot." "This unit made me feel more confident about math or science." "I feel using challenges is a more effective way to learn than the way we are usually taught." (Scale: 4=strongly agree, 3=agree, 2=disagree, 1=strongly disagree)	Student Feedback Survey • 90.2% of students *agreed* or *strongly agreed* that they "learned a lot" from these units. (n=3040, mean=3.24, SD=0.652) • 66.8% of students *agreed* or *strongly agreed* that the unit made them "feel more confident about math or science." (n=3012, mean=2.83, SD=0.847) • 81.2% of students *agreed* or *strongly agreed* that using challenges was "a better way to learn than" how they are usually taught. (n=3021, mean 3.15, SD=0.795)
Teacher Post Unit Survey "Students mastered the expected material."	Teacher Post Unit Survey • 89.2% of teachers *agreed* or *strongly agreed* that their students mastered the expected unit content. (n=74, mean=3.19, SD=0.612), a 9.7% increase from last year

Project Goal 2. Increase 6-12 student knowledge of math and science content when taught using engineering as a context for learning.

Evaluation Question 2. To what extent do student math and science content scores increase as a result of unit implementation?

Evaluation Instrument/Metric	Results and Outcomes
(Scale: 4=strongly agree, 3=agree, 2=disagree, 1=strongly disagree)	• No differences by Teacher Cohort • Teacher quotes: o *"They learned more about the topic than I usually teach."* o *"The students showed great gains between the pre and post-test, as well as their designs were more detailed, related to content."* o *"The students gained a deeper understanding of DNA and its structure and function and how it is used to solve crimes and identify individuals. It cleared up some previously seen misconceptions about DNA and where it comes from. Test scores showed a dramatic increase."*
Teacher End-of-Year Focus Groups *Annual focus groups (60 minutes) were conducted at the end of each implementation year per cohort. Protocol was developed to assess student learning and future program modifications for improvement.*	Teacher End-of-Year Focus Group Quotes • Teachers observed gains in students' skills and content knowledge: o *The impact it had on them, I've never had students feel like they're successful until CEEMS.* o *CEEMS challenged even my high-achieving students.*

Project Goal 3. Develop math and science teacher knowledge of challenge-based learning, engineering, and the engineering design process as instructional strategies through explicit training and classroom implementation support.

Evaluation Question 3a. To what extent and in what ways has teachers' knowledge increased in 1) CBL and 2) EDP?
Evaluation Question 3b. What CEEMS project activities supported these changes?

Evaluation Instrument/Metric	Results and Outcomes
Teacher Current Instructional Practices Survey *Teacher challenge based and design based learning instructional practices were assessed via a modified version of a pre-post survey developed by researchers at the Evaluation & Assessment Center for Mathematics and Science Education at Miami University, Oxford, OH, using an EDP-related construct consisting of 6 practices (alpha = 0.84).* The Current Instructional Practices survey has two batteries of 15 questions listing the same challenge based/design based learning practices. One battery of questions asks about participants' incorporation (USE) of these practices into instruction and the second battery of questions asks participants to indicate their level of confidence (CONFI) when using these instructional practices.	Teacher Current Instructional Practices Survey (Tables B and C) • Across the five cohorts of teachers (n=79), all teachers increased their use of EDP practices from **Pre**-CEEMS to one year of programming (**Mid**-CEEMS) and increased their confidence in these practices. • For Cohort 1, 2, 3, and 4 teachers (n=48), there was an increase in regular use of EDP practices and in teacher confidence from **Pre**-CEEMS followed through two years of programming (**Post**-CEEMS). o As expected, with more training and experience, a continued significant increase was seen between the first and second year (Mid to Post, n=45) in teacher **confidence** (see Table C). o While teacher use of EDP practices also increased between the first and second year (Mid to Post, n=46), the increase was not significant for teacher **use**. • Through two years of follow up, teachers maintained significant increases compared to Pre-CEEMS usage and confidence (n=11 for Cohorts 1, 2 and 3, n=6 for Cohorts 1 and 2).

Project Goal 3. Develop math and science teacher knowledge of challenge-based learning, engineering, and the engineering design process as instructional strategies through explicit training and classroom implementation support.

Evaluation Question 3a. To what extent and in what ways has teachers' knowledge increased in 1) CBL and 2) EDP?
Evaluation Question 3b. What CEEMS project activities supported these changes?

Evaluation Instrument/Metric	Results and Outcomes
Teacher Current Instructional Practices Survey (cont'd) Within the USE battery, there are three constructs identified: CBL, which includes all 15 questions in the battery; Guide, which includes the questions related to the teacher guiding CBL& EDP in the classroom; and Provide, which consists of teaching practices related to providing opportunities for EDP implementation. Note: Constructs for both the USE and CONFI batteries are contained in Appendix A.	**Table B. Teacher Instructional Practices - USAGE**

Table B. Teacher Instructional Practices - USAGE

Construct Over Time	Mean Difference (Time 2-Time 1)	Std. Deviation	t	df	Sig. (2-tailed)
PreUSE_CBL to **Mid**USE_CBL	0.78	0.650	10.685	78	.000
PreUSE_Guide to **Mid**USE_Guide	0.83	0.749	9.855	78	.000
PreUSE_Provide to **Mid**USE_Provide	0.86	0.759	10.066	78	.000
PreUSE_CBL to PostUSE_CBL	0.97	0.659	10.241	47	.000
PreUSE_Guide to PostUSE_Guide	1.04	0.680	10.584	47	.000
PreUSE_Provide to PostUSE_Provide	1.10	0.674	11.277	47	.000
PreUSE_CBL to Post1USE_CBL	0.77	0.601	4.224	10	.002
PreUSE_Guide to Post1USE_Guide	1.27	0.677	6.236	10	.000
PreUSE_Provide to Post1USE_Provide	1.27	0.518	8.151	10	.000
PreUSE_CBL to Post2USE_CBL	1.03	0.636	3.958	5	.011
PreUSE_Guide to Post2USE_Guide	0.93	0.653	3.500	5	.017
PreUSE_Provide to Post2USE_Provide	1.28	0.899	3.483	5	.018
MidUSE_CBL to PostUSE_CBL	0.10	0.396	1.767	45	.084
MidUSE_Guide to PostUSE_Guide	0.03	0.426	0.553	45	.583
MidUSE_Provide to PostUSE_Provide	0.04	0.409	0.625	45	.535

Project Goal 3. Develop math and science teacher knowledge of challenge-based learning, engineering, and the engineering design process as instructional strategies through explicit training and classroom implementation support.

Evaluation Question 3a. To what extent and in what ways has teachers' knowledge increased in 1) CBL and 2) EDP?
Evaluation Question 3b. What CEEMS project activities supported these changes?

Evaluation Instrument/Metric	Results and Outcomes
	Key Cohorts 1, 2, 3, 4, and 5 (1 year of use) — Cohorts 1, 2 and 3 (1 year post follow up) Cohorts 1, 2, 3, and 4 (2 years of use) — Cohorts 1 and 2 (2 years post follow up)

Teacher Current Instructional Practices Survey (cont'd)

Within the CONFI battery, there are three constructs identified: CBL, which includes all 15 questions in the battery; Guide, which includes the questions related to the teacher guiding CBL& EDP in the classroom; and Provide, which consists of teaching practices related to providing opportunities for EDP implementation.

Note: Constructs for both the USE and CONFI batteries are contained in Appendix A.

Table C. Teacher Instructional Practices - CONFIDENCE

Construct Over Time	Mean Difference (Time 2-Time 1)	Std. Deviation	t	df	Sig. (2-tailed)
PreCONFI_CBL to MidCONFI_CBL	0.75	0.748	8.756	76	.000
PreCONFI_Guide to MidCONFI_Guide	0.85	0.726	10.233	76	.000
PreCONFI_Provide to MidCONFI_Provide	0.83	0.776	9.422	76	.000
PreCONFI_CBL to PostCONFI_CBL	1.02	0.824	8.538	47	.000
PreCONFI_Guide to PostCONFI_Guide	1.17	0.655	12.401	47	.000
PreCONFI_Provide to PostCONFI_Provide	1.19	0.699	11.839	47	.000
PreCONFI_CBL to Post1CONFI_CBL	1.23	0.637	6.391	10	.000
PreCONFI_Guide to Post1CONFI_Guide	1.29	0.771	5.551	10	.000
PreCONFI_Provide to Post1CONFI_Provide	1.15	0.673	5.677	10	.000
PreCONFI_CBL to Post2CONFI_CBL	1.13	0.818	3.370	5	.020
PreCONFI_Guide to Post2CONFI_Guide	1.30	0.590	5.398	5	.003
PreCONFI_Provide to Post2CONFI_Provide	1.67	0.408	10.000	5	.000
MidCONFI_CBL to PostCONFI_CBL	0.26	0.667	2.571	44	.014
MidCONFI_Guide to PostCONFI_Guide	0.22	0.544	2.752	44	.009
MidCONFI_Provide to PostCONFI_Provide	0.23	0.455	3.329	44	.002

Key

Cohorts 1, 2, 3, 4, and 5 (1 year of use)	Cohorts 1, 2 and 3 (1 year post follow up)
Cohorts 1, 2, 3, and 4 (2 years of use)	Cohorts 1 and 2 (2 years post follow up)

Chi-square indicates significant differences (at 95% CI) from pre- to post-project distributions for all constructs. Results are cumulative across all matched and available data for Cohorts 1, 2, 3, and 4. Cohort 4 does not have post-data in Year 5.

Project Goal 3. Develop math and science teacher knowledge of challenge-based learning, engineering, and the engineering design process as instructional strategies through explicit training and classroom implementation support.

Evaluation Question 3a. To what extent and in what ways has teachers' knowledge increased in 1) CBL and 2) EDP?
Evaluation Question 3b. What CEEMS project activities supported these changes?

Evaluation Instrument/Metric	Results and Outcomes
Summer Institute for Teachers (SIT) Evaluation Survey *Teachers rated the usefulness of various SIT interactions and workshops.* (Item categories: 1= very useless, 2= useless, 3=useful, 4 = very useful)	Summer Institute for Teachers (SIT) Evaluation Survey • 97.1% of teachers reported overall interactions with resource team were *useful* or *very useful*. (n=35, mean = 3.69, SD = 0.530)
Teacher Post Unit Survey "I felt I had enough understanding of the CBL approach to guide my students so they got the most from this experience." "I felt I had enough understanding of the engineering design process (EDP) to guide my students so they got the most from the EDP activity or activities implemented in this unit." (Scale: 4=strongly agree, 3=agree, 2=disagree, 1=strongly disagree)	Teacher Post Unit Survey • Cohort 4 teachers (with two years of experience) showed slightly higher means for CBL as Cohort 5 teachers (one year of experience), but slightly lower means for EDP as Cohort 5 teachers. These differences were **not** significant by cohort. o Regarding understanding CBL to effectively guide their students, Cohort 4 teachers (n=44) had a mean of 3.57 compared to Cohort 5 teachers (n=29), with a mean of 3.48 (F = .502, p=0.481). o Regarding understanding of the EDP process to effectively guide their students, Cohort 4 teachers (n=44) had a mean of 3.59 compared to Cohort 5 teachers (n=30) of 3.63 (F = .131, p=0.718). • 100.0% of teachers *agreed* or *strongly agreed* that they had enough understanding of CBL to effectively guide their students through the experience. (n=73, mean=3.53, SD=0.502) • 100.0% of teachers *agreed* or *strongly agreed* that they had enough understanding of the EDP process to effectively guide their students through the EDP activity and unit implementation. (n=74, mean=3.61, SD=0.492)
Teacher end-of-year focus groups Annual focus groups (60 minutes) were conducted at the end of each implementation year by cohort. Teachers were asked about	Teacher end-of-year focus groups • All CEEMS teachers learned how to think about and teach CBL and EDP to students: o *Summer [SIT] classes… enlightened my thinking as a teacher.* o *You feel guilty doing anything traditionally.*

Project Goal 3. Develop math and science teacher knowledge of challenge-based learning, engineering, and the engineering design process as instructional strategies through explicit training and classroom implementation support.

Evaluation Question 3a. To what extent and in what ways has teachers' knowledge increased in 1) CBL and 2) EDP?
Evaluation Question 3b. What CEEMS project activities supported these changes?

Evaluation Instrument/Metric	Results and Outcomes
project activities and what they learned.	• Teachers received support during the academic year from the resource team members. o *My resource team member was unbelievably useful.* o *Having that engineer, [being able to] bring their expertise in if you weren't getting something to work.* o *I liked having someone to bounce ideas off of. He challenged my students.*

Appendix A. Current Instructional Practices Instrument – Constructs

Current Instructional Practices Instrument – Constructs

In order to document changes in teacher content knowledge, attitudes, and behaviors in the classroom, an overall repeated measures survey was developed that documents participating in-service teachers' self-reported current instructional practices that are associated with challenge based and design based learning. This survey is based on an instrument developed by researchers at the Evaluation & Assessment Center for Mathematics and Science Education at Miami University, Oxford, OH and was modified with their permission.

The Current Instructional Practices survey measures self-reported changes in the instructional practices of the CEEMS teachers. The survey has two batteries of 15 questions listing the same challenge based/design based learning practices. One battery of questions asks about participants' incorporation of these practices into instruction (USE) and the second battery of questions asks participants to indicate their level of confidence when using these instructional practices (CONFI).

In May 2014, a factor analysis was conducted on the survey and three factors were identified using data collected from pre-project administration of the surveys to CEEMS teachers. The first factor is the entire battery: "CBL". The second factor consists of the practices that start with the word "Provide" (questions 8, 9, 11, 13, 14, 15) that relate to EDP implementation. The last factor consists of the statements starting with "Guide" (questions 5, 6, 7, 10, 12) that are related to the teacher guiding the CBL and EDP process in the classroom.

Table A1. Survey Items in Each Construct (Both USE and CONFIDENCE)

	Construct		
Item	CBL	**Provide**	*Guide*
1. Explicitly connect class content to complex problems or issues with global impact	X		
2. Explicitly connect class content to real world examples and applications	X		
3. Explicitly connect these real-world applications to STEM careers	X		
4. Explicitly connect class content to how people in STEM careers use their knowledge to address societal impacts	X		
5. Guide students to break complex global problems in to their local and more actionable components	X		*X*
6. Guide students in refining problems	X		*X*
7. Guide students in planning investigations to better understand different components of problems	X		*X*
8. Provide opportunities for students to gather information about problems or issues of importance	X	**X**	

Item	Construct CBL	Provide	*Guide*
9. Provide students with opportunities to explore multiple solution pathways for problems	X	**X**	
10. Guide students in weighing the pros and cons of different solution pathways	X		*X*
11. Provide opportunities for students to test their solution pathways	X	**X**	
12. Guide students in evaluating the results of their solution pathways	X		*X*
13. Provide students with opportunities to refine and retry a solution pathway	X	**X**	
14. Provide opportunities for students to communicate their solution pathways and results to others	X	**X**	
15. Provide opportunities for students to take responsibility for the decisions they made about the processes used in solving complex problems	X	**X**	

*Items in bold denote "Provide" construct, and items in italics denote "Guide" construct.

Reliability of the scale used on the survey was analyzed using Cronbach's alpha statistic and it was determined that all administrations of the surveys had a high level of reliability for the entire group of usage statements and the usage survey questions that are included in the "Provide" factor. The "Guide" factor usage statements had a higher, but not good, pre-project administration reliability but then the reliability for the questions in these factors decreased to very low levels in the mid-project administration. By contrast, overall survey and statements related to all factors had acceptable reliability scores for the Confidence questions. Cronbach's alpha is a coefficient of reliability based on a 0 to 1 scale. For social science research, scale reliability values greater than or equal to 0.7 are desirable. A summary of Cronbach's alpha statistics from July 2016 are shown in Table A2 below. These survey scale analyses indicate that the survey should continue to be used to gauge teachers' self-reported instructional practices related to CBL and EDP.

Table A2. Current Instructional Practices – Cronbach's Alpha Reliability Analysis

Cronbach's Alpha - Scale Reliability, July 2016	Use Statements	Confidence Statements
PRE-Project		
CBL	0.908	0.940
Provide	0.887	0.905
Guide	0.780	0.858
MID-Project		
CBL	0.832	0.933
Provide	0.862	0.908
Guide	0.601	0.815
POST-Project		
CBL	0.864	0.934
Provide	0.871	0.885
Guide	0.641	0.784

Appendix B. Open Ended Responses from Teacher Post Unit Survey

Question: How did your students benefit from participating in this unit?
Real World Application
Many are now more conscious of their energy requirements and are telling me they are using the app they created-most gained confidence in their use of excel
Abstract ideas to something concrete
Got additional practice with graphing equations in slope intercept form while solving a real world application problem learned about the golden ratio learned about design aesthetics
My students benefited from participating in this unit because it gave them an opportunity to talk about the math they are learning in a real-world situation that they cared about. It's very difficult to get students to talk about the math they are learning, but throughout this unit my students talked about functions, key features of functions, and how these connected to energy. By the end of the unit students had a much stronger knowledge of key features of functions and what types of functions can look like. I have seen a very big difference in the units following this CEEMS unit. The students are more comfortable analyzing functions and have a higher success rate when identifying the key features of functions than my students in previous years.
My students were able to see calculus in application
Real world connection to building a home and learning about what Civil Engineers do
Students gained real world experience by using linear equations used in everyday life as well as in the business world.
Students saw how concepts they learn in class can be applied to create socially responsible new products that can be profitable in the marketplace. They also have a better understanding of the economic hindrances to clean energy development.
Students were able to connect Punnett squares and pedigrees to real world situations and research how dogs benefit society. Students gained a better understanding of other people and their needs for designer dogs including police dogs and therapy dogs.
The students benefited from this unit by seeing a real life application in today's world on surface area. They also benefited from having to work in groups and communicate their solution to their peers to enhance both of these skills.
The students experienced real world deadlines. They had the opportunity to use their knowledge of slope to create real world slopes.
The students gained a deeper understanding of DNA and its structure and function and how it is used to solve crimes and identify individuals. It cleared up some previously seen misconceptions about DNA and where it comes from. Test scores showed a dramatic increase.
The students were able to see how energy transfers in real world applications. It also further their knowledge of potential and kinetic energy.
They learned about team work, perseverance, critical thinking, how cars work/function, and how to model real things with mathematical equations.
They practiced skills in applying research from direct experimental data to real world engineering.
They used the content knowledge for real world application.

Question: How did your students benefit from participating in this unit?
They were able to determine what human activities contribute to global climate change.
They were able to see a practical application of calculus with physical activity.
They were able to see how the content is applied in the emergency management system that is used to prepare communities for severe weather or other emergencies. They were also able to look at their final solution and compare it to what is already in place to see if they agree or disagree with the current system.
They were able to see how the math involved in electricity could be used to help them design quilt squares that used LED bulbs to light up features of linear equations.
They were able to see why parabolas are an important concept to learn about because they have features that make them useful in the development of much of our technological advances.
They were given a real-world situation that they have the power to help solve. They saw relevance big time!
They were made to come up with multiple solutions to a problem. They were able to take a math problem and create a real-life scenario for it
Engagement
Benefit from review magnets and electricity. Plus, this was high interest and fun. They got to experiment and try different variables. They got to overcome fears of being shocked
Many of the students expressed how they enjoyed making the water filters, but I noticed that they were not comprehending many of the concepts presented. They did benefit from working in groups because they exchanged ideas and worked on cooperative skills.
More engagement and incorporated real life skills other than building a barrier.
My students applied their knowledge of topography to a real life situation and had practice presenting their ideas to the class.
My students benefited from participating in this unit by having a greater ownership of their learning, they were more engaged, and were willing to keep trying when things were difficult.
My students loved this unit. They were incredibly engaged the entire time and they developed a great understanding of the EDP.
My students were highly engaged during this unit and used content language and science concepts during the challenge.
My students were so engaged in this challenge. Each team faced difficulty and frustration, but ALL teams succeeded at some point during the challenge. The discussions about team work, being successful in completing the challenge, and communicating failures as well as successes were so meaningful. My students were proud of their accomplishments, and candid about their failures. Not only did my students learn scientific content, but they also practiced meaningful life skills such as communicating and practicing persistence.
They were highly engaged in a challenging activity that forced them to work with their peers in a cooperative way. Students were challenged to see if their original ideas/design matched their final product.
They were very engaged in the material, and tried very hard since they were going to present to the principal.

Question: How did your students benefit from participating in this unit?
Collaboration/21st Century Skills
Developed leadership skills, increased their motivation to learn, high level of engagement, took their team roles seriously, increased their knowledge of solving linear equations, students learned how to use animation software (self-taught), further developed their presentation skills.
I believe they really improved their team work skills because this was a very challenging unit. They also sharpened their research skills as I asked for quite a bit of scientific backing before they were allowed to build their prototype helmet.
My students benefited in several ways from participating in this unit. First, they were able to gain solid content knowledge in the area of evolution. Next, they developed a great sense of team work throughout the unit. There were several teams who worked great together and others who developed that cohesiveness as the unit went on, but in the end everyone did well. Finally, my students were able to solve a problem by implementing the EDP. They struggled with the idea that there was not one correct answer and that they could develop their own solution, but just like with the team work, they came through in the end.
My students got a lot of practice speaking in front of their peers which is something that was new to them. They also learned to work with other students.
My students showed leadership in their teams, worked together to develop the best result AND maximized the test/design/redesign model very well
Team work development, collaboration skills, flexible grouping allowed them to come out of their comfort zones and work with students they wouldn't normally work with.
Team work, collaboration and communication skills increased. Students received a chance to see how math calculations are directly related to rate of change, graph creation, and real-world applications.
Team work, content knowledge, fun, discussion.
They also gained skills in team work and organizing their findings to be clearly communicated to others.
They gained experience with working in teams, which is still a major challenge for many of my students.
They increased their financial literacy by learning about loans, interest rates, and budgeting money. They increased their teamwork skills. They increased their technological knowledge of google spreadsheet.
They strengthened their communication skills, critical thinking, and learned the topic on a deeper level.
This was one of the best units that I have done. It allowed students to apply their knowledge of probability to designing a board game. I saw leadership and collaboration happen that I haven't seen at this level before. They keep talking about how much they loved this unit.
Working in teams and listening to all team members' views and ideas. Adapting when going from paper designs to actual construction. Using budget and weight goals to make things measurable and a definable challenge also helped.

Question: How did your students benefit from participating in this unit?
Working in teams proved to be a challenge at the start of the unit, however, midway through I was impressed with how my students learned to collaborate and make adjustments. The team aspect was wonderful. Students were also deeply engaged in their learning. The "pitch to producers" was the culminating project that really showed their mastery of the content. I was extremely pleased and super proud of my students.
Creativity/Problem Solving
My students really excelled in the design portion of the unit this year. Their creativity flourished. Their sketches were beautifully labeled and attention to detail was paid without any assistance from me.
My students were very engaged with this unit. They were able to be creative while making the Rube Goldberg machine and apply the content to the challenge. Students went through the EDP and had practice revising their product a lot.
Students really had to think and problem solve during this unit. It was complex material and very student led which caused them to make big decisions on their own.
Practiced and demonstrated problem solving skills, increased content knowledge, improved communication and collaborative skills, brainstormed and built ideas to see how ideas can be transferred from one person to another.
Creativity knowledge. Team work.
They learned how to work in teams. They discussed that thinking critically and outside of the box is important. That the right solution isn't always the only solution and sometimes you have to experience frustration &/or failure to arrive at something great. They gained a deeper understanding of what engineers do.
Thinking outside of the box. Communicating with others and debating ideas for an agreed upon plan as a group. Delegating tasks within the group.
This unit really revealed the creativity and leadership skills of the students. Each team had a unique design that they valued and believed in. They worked well to come up with, test and present a solution in a strict time frame.
They really got a good handle on how traits are passed from parent to offspring. They were able to solve a problem and present it in a unique way.
Content Knowledge/CBL/EDP
Demonstrated by the post assessment results, students showed a significant improvement in content knowledge of elements, compounds, and mixtures. Students learned and applied proper lab safety protocol, had direct experience with measurements of different units (mL and g), following lab procedures to create a successful product, and were able to take product home and test. Students showed engagement and ownership in learning, and expressed they enjoyed creating a solution to the problem presented.
Extremely well- average % growth from pre to post was 32%
I felt like my students had a much better understanding of density and how particles are arranged in matter after completing this unit. I felt like they could more easily explain the terms using many examples from the activities from our unit.
I think my students have a much clearer understanding of kinetic and potential energy with this unit. I also think they really understand the importance of wearing a helmet for many activities they had not considered before. I think they understand what can happen if they experience a brain injury.

Question: How did your students benefit from participating in this unit?
Student's used the Engineering design process to successfully prevent an acorn squash from being damaged by designing, building, and testing their prototypes. At the end, students understood that the more mass added to the helmet, the more force impact was created.
The students showed great gains between the pre and post-test, as well as their designs were more detailed, related to content.
The students showed knowledge growth between the pre-test and the post-test.
Learned EDP
They benefited by going through the engineering design process and applying the content to a challenge.
They learned more about the topic than I usually teach
All Others
A STEM encore class also completed this project (or a similar one this year), so most of my students had already done something very similar and were therefore not as interested in the challenge.
My students were able to develop their projects and test and redesign. This was not in the original plan and I think they really got a lot out of that.
They were able to see they can make and test a prototype. Learned several new technologies
They were able to learn a new skill - creating a spreadsheet. Also, how to use technology to make work easier.
Year-long seeing how waste changes over time to something usable

Question: If you were to teach this unit again, what specific modifications or adjustments would you make?
Add a gizmo Get new bromothymol blue virtual flyer?
Additional time and materials
After second round satisfied with results, nothing
Alter the assessment according to the changes described below: The pedigree questions I used on the assessment did not use a heterozygous/carrier symbol (half shaded). The symbols are only fully shaded or not shaded and this is different than all of the example we did as a class and the examples that the students made. This is my fault for not showing them an example like this, or using a different question on the assessment. It ended up being a really great learning point but it left a lot of kids frustrated and as a result I will change the assessment in the future.   Challenge: Give more specific requirements about the Punnett squares and pedigrees including: 16 square 2 pedigrees with labels and keys Estimated Timeline Incorporate a more clear career connection in the research
Change portions of the end rubric. Provide a timeline/checklist with which to work from. Have students keep track of their team members attendance and contributions on a daily basis.
Clearer expectations for the presentation, mini-lessons on sewing.
Different materials and different concept.
Due to time constraints I was unable to teach all the components planned in this unit. Next time I would like to teach all the components which should help students understand the end product better.
Find more cars so I can test multiple at once
Find participants that are in the area and able to come in and meet face to face with my students. More google spreadsheet training - "how to" guide.
First, I wish I had more time. The students do a great job in the development of their game, but if they had more time to revise, their finished product would just be better. My other modification would be resources. I had a great amount of resources, but some of the teams had great ideas with resources (electric lights, timers, sounds) that I just couldn't provide.
Give students more time to complete their design build in a day where students learn the technology a bit more increase the expectations from 10 equations to 30 equations
Give students more time to research how cars work Give students more materials that are more sturdy. Give students more guidance with their presentations.
Have more robots or use remote control cars. I would possibly have students build gates.
Honestly, none with the challenge. I would modify the Yahtzee activity leading up to it - students felt overwhelmed in not knowing how to approach exploring probability - need to stress more that there is no one correct answer, but can explore all parts.
I added math requirements to my unit as a last minute idea. The next time I do this unit in my classroom, I will make calculating potential energy part of the challenge. This was so helpful in

Question: If you were to teach this unit again, what specific modifications or adjustments would you make?
connecting their design to real world situations. As always, if I could add more time to this unit, I certainly would!
I think we needed an extra day for the presentation piece. I had to rush students towards the end when I really would have liked to take more time to talk about business seminars, sales pitches, and allowed more time for student questions.
I tried to add in the teaching of variables and the need to teach one variable at a time. This greatly limited my ability to have the students use CBL and EDP most effectively.
I will change the online simulation from the Energy Skate Park to the Gizmo activity next year. Skate Park did not work for on our computers. I will also look at changing the materials for the marble lab so that the student results are more conclusive.
I will teach the content first and then do the challenge.
I would add a writing or reflection component to the project so that students could more directly tie what they were seeing and the changes they had to make to their roller coaster to energy and energy transformation.
I would add more requirements for sketching their topographic map and attraction before they start building the 3-D model. I would add more specific criteria for the presentation.
I would add on at least one more day for the students to be able to revise/practice their presentations.
I would change the challenge to include to more student led solutions. the students need to come up with more possible solutions to the challenge on their own before starting the implementation process. Also, I would modify the area of space used to include a premade car track to help stabilize the machines.
I would change the materials given (i.e. remove tape from the list). Also, I would be more explicit with the design parameters and have students design the filter one stage at a time. I would set daily goals for groups and this in turn might help shorten the implementation schedule.
I would focus more towards the math necessary for the class as this seemed to miss the mark. I would also try and find a way to extend the quadratic connection to these bridges to some form of polynomial connection, such as to strength testing bridge materials themselves.
I would give more time. My students were headed toward outstanding finished products but I had to cut them short. Their final products still met the requirements but another day or two of revisions would have been nice.
I would give them more background information at the beginning. I had 6 of 10 meet the challenge of a 10 decibel reduction. I will try to add materials in the future.
I would have a discussion on pricing the product for the highest profit, prior to students having sold their items. I tried to teach this through the worksheets student had to complete, but somehow the students did not understand the purpose of the pre-work. They simply chose a price they wanted to charge, without much thought on their cost. Also, I would do more collaboration with the art teacher,

Question: If you were to teach this unit again, what specific modifications or adjustments would you make?
and have students make their product in art class; which would allow me to focus more on the math skills.
I would have the students create a personal budget in order to tie it in personally to them
I would have the students present to the fifth graders in different rooms. Having them all present in the same room got too crowded and loud. I would also change the rubric to better reflect the abilities of the students that I had this year.
I would have them focus on specific aspects of solving linear equations, like combining like terms, variable coefficients, variables on both sides, decimal/fraction coefficients.
I would laminate the map sections so that they can be used over and over again. This will also allow for easier corrections to be made if the teams so choose to by being able to use dry erase markers or wax pencils. I will also make sure that all of the maps have the same scale factor so that it is easier to convert the actual dimensions.
I would like to add robot arms to the challenge. So time for building would need to be added. I will also need another day for electricity next year since it was not taught in 7th grade this year.
I would like to incorporate more usage of finding the surface area (only had to do it on one shape). I also may incorporate volume in conjunction with surface area next time.
I would make students spend more writing and practicing their script. I would make it mandatory that I sign off on their script. One group left out a major requirement of the video.
I would make sure that the students have the opportunity to have the educational tool evaluated by their peers and are able to redesign.
I would make teams only 2-3 students and I would have all students involved in the presentations. I would change the obstacle course to only be a baby pool and get more small fans so more teams can practice at one time.
I would make the boards foam grids, so students can see the slope.
I would make the design challenge more challenging. I would require 20% of the top of the can above the water. I would also remove balloons from materials list. The dancing raisin lesson needs to be revised since most students didn't see the raisins move to the top.
I would make the student groups smaller. There were too many students just sitting and letting one person do all the work. I would have a typed copy of the tutorial for students. It was difficult for them to read off of a split screen, due to the size of the student computer.
I would not change too much- we struggled at first with getting accurate sensor readings, so the adjustments were made during the unit implementation.
I would not give students a procedure to determine how effective their method was. I would allow them to come up with their own method to measure the amount of oil collected or describe its effectiveness using other evidence.

Question: If you were to teach this unit again, what specific modifications or adjustments would you make?
I would shorten the time on the homeostasis lab in order to be more time efficient. I would allow for additional time during the card sort in order to review the correct answers with the students before they copied the information down in order to not reinforce misconceptions.
I would show them the correct way to assemble their finished cells overtly, rather than having them figure it out- the time it took wasn't worth what they got from doing on their own, and many would never have figured it out.
I would teach students how to give a presentation.
I would teach the students prior to the lesson how to use Tinkercad, this was difficult to use for students to meet their targeted deadline.
I'd let them do a lot more research.
If I were to teach this unit again I would guide the students in my lower level classes more. I would have checkpoints and check ins with those groups to insure they were staying on task and knew what the expectations were. I would also buy pre-made gels for the electrophoresis and or demo the actual gel electrophoresis lab. Completing it with such large numbers was not something I would do again and it required more time than I would have liked. If possible I would have liked to be able to record the clips of the OJ Made in America video so they would run continuously because taking the time to find the clips as we watched also used up time that I didn't want to spend on fast forward.
If I were to teach this unit again I would put students in pairs instead of groups of 3.
If I were to teach this unit again, I would allow students to use materials from home.
Keep the final challenge (modified version) where students made housing application packets. Remind students daily how their work is fitting in with the EDP. Provide pictures for students to color rather than spend so much time having students draw the pictures themselves. Download video clips. They were no longer available on YouTube and messed up the hook.
Keep with the smaller rain barrel size
More guidance in the data analysis process, being given so much data was overwhelming for students
More information on some design aspects
My plan for 3D printing was drastically modified during the unit because of the time constraint of using 3D printers. Next year, students will have the option to work on 3D designs if they finish a physical model first.
Next time, I plan on having students show me their design sketches before they can start using materials. I also plan on having students change their design sketch once they finalize their machine.
Possibly adding different building materials
prior to starting the unit, eliminate parts of the stations lab (not a part of unit) to make the unit more authentic and "new" info. I plan to eliminate stations 5,7,8,9 next year to help with the pre test scores/prior knowledge being skewed. Buy more playdoh to have 2 containers per student Read the

Question: If you were to teach this unit again, what specific modifications or adjustments would you make?
step by step directions for the Play-Doh activity with students to ensure they understand what they are doing (more success with the class I did this with than the one I did not) Consider incorporating a wooden food skewer to poke down the middle of the playdoh mountain to ensure it is put back together correctly When student groups make their practice sales pitch to the other group, have them write down 2 strengths and 2 weaknesses to give back to that group incorporate these into the "Redesign" of the sales pitch.
Provide more details for the activity where students had to trace the path of the contaminant in the form of bullet points on a print-out sheet of paper. I would do this so that they could refer to the document during the lab. Students quickly forgot why they were testing soil samples and how pH corresponded to the contaminant. I will make sure that students spend time analyzing the materials and work as a class to explain how the materials will assist in removing pollutants from the water. We will then make a chart and keep it posted in the classroom as a reference during the challenge. Checkpoints will be enforced. If a group does not complete a step, they will have to conference with me and show understanding before being allowed to move on to the next step.
refinement part of the cycle would be more guided, and I would do more math review before the unit
Require students to focus more of the building of their umbrella on congruent triangles, not just around being successful in the testing phase.
Small classes not all students it took up a lot of space. Figure out how to get waste consistently
Students made a 2 dimensional topographic map. Next time I would like to give students the option of making a 3 dimensional topographic map.
Teach presentation skills.
There is not much I would modify about this unit besides making sure to emphasize the content calculation practice a little more frequently next year.
There was improvement from first unit taught with the exception of material management. One of the student's homework assignments was to take their test tube home (with first iteration of shower gel) to try out and return test tube to school within two days for second iteration and modification of formula. It took extreme prodding to obtain most of the test tubes back to be able to complete final version of soap product. This caused the challenge itself to be prolonged past initial timeline. Another change should be modifying the hook. Students observed and evaluated physical properties of various kinds of soaps (hand soap, body wash, shampoos, dog shampoos). I would like students to actually test the effectiveness of different kinds of soaps by washing away various kinds of substances. The issue is management of space and resources: amount of soap and access to enough sink space to provide a structured environment for students.
Time management and more teacher checks throughout the EDP process.
Timing should be more concise after first attempt at implementation, set more clear expectations for teamwork to guide moments of discourse and resilience, remove watershed activity because it was not proper grade-level material, be more strict on deadlines for activities (students created a comic strip

Question: If you were to teach this unit again, what specific modifications or adjustments would you make?
demonstrating a water droplet going through the water cycle- some wanted to make an extremely detailed final comic but needed more time than allotted).
Try to have the unit not interrupted by snow day!!
When I do this unit again I will make sure that the students find the percent increase in temperature so that they can make solid conclusions on whether a certain design works better that others and make predictions as to why they make those conclusions.

Please share any additional thoughts or feedback.
3D printing is time consuming to learn, practice and actually print. Students will do this more on their own time or during "extra time" rather than planning to use class time.
Allowing students to make their own version of a sales pitch created a more interesting presentation compared to last year when everyone made a brochure
Good unit. I will do it again next year.
Great first experience in designing and implementing CBL, I am excited to continue to modify and improve this unit and additional units to engage my students in learning content. My experience in this program has opened my mind to various possibilities and what learning can look like in a classroom.
Great unit...kids loved it
I absolutely believe that the students had the opportunity to show leadership, communication and teamwork through this unit and it greatly benefited them.
I liked the revisions from the previous year.
I love doing these units with my students. They benefit so much from working in groups as well as learning content deeply. I was so pleased with their understanding of potential energy by the end of the challenge.
I really enjoyed seeing how much the students were involved in this unit, my only concern is that it took a long time, and they didn't learn as much as they normally do when I teach this material.
I really liked this unit. The topic area isn't the most fun for the students, but in spite of how they felt about the unit there was a definite increase in learning compared to other ways I have taught it. I'm not sure their reflection of how the unit went will really mirror the benefits it had.
I saw students show leadership qualities that I didn't know they had until we did this unit.
I think that overall the unit went very well. Students were engaged and data showed gains between pre and post-test.
I was thrilled with the student presentations. I was worried it we take me 2 days just to teach how to use Google Slides, but I was mistaken. Student presentations were very creative and most had more than the required elements in their presentation. I also felt the tool I used to move them through the design process was very useful for them while designing their life vest and for their presentations.
I was very happy with this unit. My students completed this unit in half the time of the previous unit. All of my students were able to explain the difference kinetic and potential energy, which showed the success of the unit. I am looking forward to teaching this again next year.
I wrote a lot of modifications on the Unit Review and spoke for 45 minutes with the resource team about unit improvements and pros/cons.
It was very helpful to have my resource team in the classroom and help me with implementation.
It went great! This was the second time I did this unit and I will continue to do it!

Please share any additional thoughts or feedback.
Jack has been very helpful in the reflection process and allowing me to see how I can improve my units. It can be tough to see from your own lens, but the resource team is helpful and useful!
More time/resources needed to fully edit Algebra tutorials.
Special thanks to my resource team member, Tom, for coming in 304 times and being a great resource for the kids!
Overall the unit was successful, I wish that we were not running out of time due to the holiday break.
Overall, a positive and effective unit to introduce properties of matter. Timing can and will be improved next time unit is taught with modifications to the hook and actual challenge with regard to classroom space and materials. I plan on teaching this unit again with extra resources and activities before and after the challenge occurs. I was very pleased with engagement and students expressed an enjoyment to create and test something that they made themselves.
Students really enjoyed the hands-on activities.
The hook was amazing! The students were very interested in the Cuyahoga River history. I was not able to continue the interest the whole time. Reorganizing the lessons may assist with this. I am not sure, but I know that there was great feedback from the students, I just didn't like their level of understanding.
The lesson was highly engaging. The engineering process was great; however, the math portion was a little less than desired. Overall, it was a success.
The unit was extremely successful. I was supposed to have a fellow come, but they never showed up one day as planned.
This unit as written is great, when I implement it in the future I will have to be mindful of the pacing guide timeline and state testing.
This unit of teaching was just awesome and I can't wait to roll it out with version 2 next year.
This unit was not implemented as intended. The class was completely changed right before implementation. The group that I was left to work with was not ideal. However, I did enjoy the unit. Students were able to display their creativity. My very busy, overly hyper student thrived during this unit.
This was a great unit to push my higher students however I'm glad I did not do it with my lower classes because the students would have not benefitted content wise from this unit. The higher students were able to make connections to the content and incorporate it into their EDP process.
This was truly a great experience. I was a bit nervous with my first class as I wasn't sure that I had buy in at the beginning, however, as we started with the activities, they became more and more excited about their products. This was a great experience for all.
Time was definitely my biggest concern with this unit being that Biology is the only graduation test course. I enjoyed the interest my students had as they completed this unit and the products in my Honors classes were very impressive. As I watched several students discussing the information they

Please share any additional thoughts or feedback.
researched I was impressed, but now as I move forward in the curriculum I feel behind and concerned. The unit definitely took more time than I would have liked.
Tom was a HUGE help as my resource team.
Tom was a huge help!
Unit went well
With this being my last unit and being more relaxed in the process of the challenge, I feel that this unit went much smoother than the rest.