Practice: Attend to Precision

Description/Evidence (Notes):

Students were engaged in the following: (Check all that apply)

	Use appropriate vocabulary and definitions in oral and/or written communication
	Measure (e.g., length, weight) with precision
	Label accurately when measuring, graphing, etc.
	Express numerical answers with a degree of precision (e.g., rounding error)
	Calculations are accurate

Practice: Document and Explain Activity

Descriptions of Evidence (Notes):

Students were engaged in the following: (Check all that apply)

	Synthesize observational notes into an oral and/or written explanation or visual representation.
	Utilize prior experiences and/or prior knowledge to construct and/or support explanation (must be explicit)
	Explain design solution, including constraints and criteria, and/or decisions made throughout the design or activity.
	Document failures and explain how failures led to changes in design or activity
	Document process through photographs and/or video files

Practice: Analyze and Interpret Data

Descriptions of Evidence (Notes):

Students were engaged in the following: (Check all that apply)

	Construct a hypothesis or conjecture based on observations (e.g., I think the wheel is the problem because it keeps turning right instead of staying straight.)
	Use digital tools to analyze data/information
	"Testing" model/object/design (i.e., trials)
	Make changes to design based on "tests" or start anew based on "tests" (and can defend this decision – informed decision making as opposed to uninformed decision making)
	State and/or write "becauses" in relation to "tests" (e.g., This did not work because…")
	Examine object or device (e.g., turning over in hand while "studying" object)
	Persevere in solving problem

Practice: Use Mathematics and Computational Thinking

Descriptions of Evidence (Notes):

Students were engaged in the following: (Check all that apply)

	Develop visual representation(s) of observations or investigations (e.g., frequency chart, bar graph) to identify patterns
	Apply mathematical concepts and/or processes (prior knowledge) to solve problems and/or investigations (e.g., indirect measurement, estimation, number sense, proportional reasoning, spatial reasoning)
	Intuitive precision (e.g., "You've just built this tower with four toilet paper rolls and a flat piece of cardboard. Is the cardboard on the top flat? Why not?"; Are the four columns even?)
	Create algorithms that a computer can execute
	Recognize patterns and/or repeated sequences in data or code within activity

Practice: Engage in Constructive Feedback and Argumentation and from Evidence

Descriptions of Evidence (Notes):

Students were engaged in the following: (Check all that apply)

	Compare and critique at least two designs and analyze whether they meet the demands of the activity
	Provide suggestions to peer(s) in how to improve and/or change design and/or object using relevant evidence
	Construct arguments and respond to the argument of others; Explain flaw in own or peer's argument
	Make conjectures, suggestions and/or use counterexamples to support, improve, refute and/or critique the argument and ideas of others
	Defend how the mathematical results is warranted in activity, if applicable.

Practice: Obtain and Evaluate, and Communicate Information in a Responsible Manner

Descriptions of Evidence (Notes):

Students were engaged in the following: (Check all that apply)

	Engage in positive, safe and legal behavior when using technology, including online social interactions • Safe: Interactions that keep youth out of harm's way (e.g., knowing the identity of who youth are interacting) • Legal: Interactions that are mindful of the law (e.g., copyright and fair use)
	Conduct research (e.g., books, google) to inform design, investigation, interest, curiosities, etc.
	Plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits
	Evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources

Practice: Communicate/Present Information

Descriptions of Evidence (Notes):

Students were engaged in the following: (Check all that apply)

	Communicate/showcase final product, design solution, and/or activity clearly (i.e., appropriate manner that audience can understand)
	Explain the mathematical results within the context of the activity, if applicable.
	Use technology to demonstrate their learning in a variety of ways (e.g., documentation, social media, portfolio)
	Cites the work of online resources (e.g., images)
	Creates original digital works
	Repurpose or remix digital resources into a new creation

Reflective Questions

Individually, or as a team of educators, reflect upon the following questions. Provide evidence from your observation protocol.

1. Identify areas of strength and areas of improvements. Explain why you have listed these as areas of strength and areas of improvement. (e.g., Taking notes and documenting failures is an area of strength as 10 of 13 students were noted engaging in this specific practice at least once. This by nature has been built into the norms/procedures of our environment.)

2. How does the identified strengths and improvements align with your goals of the task, goals as an educator, and/or goals of your learning environment?

3. Based on areas of improvement, brainstorm and list practical changes to your pedagogical practices that align with your goals noted in Question 2.

4. Devise a plan of action around noted changes identified in Question 3, including a timeline.

STEM Practices Survey

The purpose of the survey is to assess youth's self-reported engagement in a making problem/investigation/task through a survey version of select practices. Students will then consider areas and strengths and weakness, followed by setting personal goals. All of the questions may not be applicable to the making activity, so feel free to eliminate the question. For example, question 13 asks, "Create a set of rules or code that a computer can execute."

The STEM Practices survey should only take no longer than 15 minutes to complete and should be administered at the conclusion of a making problem/investigation/task. This survey can be used in conjunction with another tool such as the observation protocol. Results between the two will highlight similarities and differences between what is observed and how youth self-reflect upon their practices.

On the next page, each survey question is aligned to the respective practice highlighted in the standard alignment on pages 5-6.

STEM Practices Survey Alignment

1. Break down activity into manageable steps [Make Sense of Activity; Plan Investigation]
2. Ask questions that required research [Ask Question/Define Problems]
3. Ask questions that required an explanation from someone else [Ask Question/Define Problems]
4. Write, draw, or explain my plans [Develop, Use Models, and Select Appropriate Tools]
5. Brainstorm plans and ideas with someone else [Plan Investigation]
6. Write down or state out loud needed material and tools to carry out plan [Plan Investigation; Develop, Use Models, and Select Appropriate Tools]
7. Keep trying when something did not work [Analyze and Interpret Data]
8. Tell someone else why something did not work [Document and Explain Activity; Analyze and Interpret Data]
9. Ask for help from someone else [Analyze and Interpret Data]
10. Document my process through photographs, video files, or notes [Document and Explain Activity]
11. Make changes when something did not work [Analyze and Interpret Data]
12. Use mathematics to solve problems and/or investigations [Use Mathematics and Computational Thinking]
13. Create a set of rules or code that a computer can execute [Use Mathematics and Computational Thinking]
14. Provide suggestions to someone else about how to improve or change their design
15. Support my own design and choices to someone else [Engage in Constructive Feedback and Argumentation from Evidence]
16. Describe how my design or object met my goals or goals of the activity [Document and Explain Activity]
17. Conduct research [Obtain and Evaluate, and Communicate Information in a Responsible Manner]
18. Evaluate the accuracy and believability of online information and media [Obtain and Evaluate, and Communicate Information in a Responsible Manner]
19. Present my final product and/or design solution [Communicate/Present Information]
20. Repurpose or remix digital resources into a new creation [Communicate/Present Information]

STEM Practices Survey

Describe the activity just completed.

<u>Based on this activity, circle the response for each item below that best captures how often you did something.</u> **<u>There are no right or wrong answers.</u>**

How often did you …?

1. Break down activity into manageable steps

   A lot Sometimes A little Not at all Not sure

2. Ask questions that required research

   A lot Sometimes A little Not at all Not sure

3. Ask questions that required an explanation from someone else

   A lot Sometimes A little Not at all Not sure

4. Write or draw my plans

   A lot Sometimes A little Not at all Not sure

5. Brainstorm plans and ideas with someone else

   A lot Sometimes A little Not at all Not sure

6. Write down needed material and tools to carry out plan

   A lot Sometimes A little Not at all Not sure

7. Keep trying when something did not work

   A lot Sometimes A little Not at all Not sure

8. Tell someone else why something did not work

   A lot Sometimes A little Not at all Not sure

9. Ask for help from someone else

   A lot Sometimes A little Not at all Not sure

10. Document my process through photographs, video files, or notes

A lot Sometimes A little Not at all Not sure

11. Make changes when something did not work

A lot Sometimes A little Not at all Not sure

12. Use mathematics to solve problems and/or investigations

A lot Sometimes A little Not at all Not sure

13. Create a set of rules or code that a computer can execute

A lot Sometimes A little Not at all Not sure

14. Provide suggestions to someone else about how to improve or change their design

A lot Sometimes A little Not at all Not sure

15. Support my own design and choices to someone else

A lot Sometimes A little Not at all Not sure

16. Describe how my design met my goal(s) or goal(s) of the activity

A lot Sometimes A little Not at all Not sure

17. Conduct research

A lot Sometimes A little Not at all Not sure

18. Evaluate the accuracy and believability of online information and media

A lot Sometimes A little Not at all Not sure

19. Present my final product and/or design solution

A lot Sometimes A little Not at all Not sure

20. Repurpose or remix digital resources into a new creation

A lot Sometimes A little Not at all Not sure

What do you think went well during this activity?

What do you think you could do differently if asked to do this activity again?

Write at least two specific goals for yourself for the next time you do a similar activity:

STEM Practices Survey Excel Scoring Guide

- **Set up the spreadsheet.** Your spreadsheet should have one column for the respondent ID and one column per item. See image below.

	A	B	C	D	E	F
1	Respondent ID	Q1	Q2	Q3	Q4	Q5
2	1					
3	2					
4	3					
5	4					
6	5					

- **Enter the data.** Convert each circled response to a numeric score (4 = A lot; 3 = Sometimes, 2 = A little; 1 = Not at all; 0 = Not sure). Enter the score for each answer into the corresponding column on the spreadsheet.

  For example, suppose Joey selected "sometimes" for Question 1, "a little" for Question 2, "not sure" for Question 3, "sometimes" for Question 4, and "a little" for Question 5. The image below illustrates the responses entered as a numeric score.

	A	B	C	D	E	F
1	Respondent ID	Q1	Q2	Q3	Q4	Q5
2	1	3	2	0	3	2
3	2					

- **Making Comparisons.** As a way to track changes from one activity/task to another. You can insert columns (Home>Insert>Insert Sheet Column) and calculate differences. Consider the example below. You can calculate the difference from the first responses (Q1-a) to the second set of responses (Q1-b) in Column D by entering =C2-B2. Once scores are entered for all respondents, you can calculate differences by dragging the green rectangle in the bottom-right of the selected cell (see Column G2).

	A	B	C	D	E	F	G
1	Respondent ID	Q1-a	Q1-b	Q1 Change	Q2-a	Q2-b	Q2 Change
2	1	3	2	-1	2	4	2

Peer Interview Protocol

The purpose of this instrument is to assess youth’s self-reported engagement in a making activity through an interview protocol between peers (e.g., Why did you choose this tool?). Peer Interview Protocols will be useful at the end of a making-related investigation/task/program. It is expected that these interviews will take between 35-40 minutes for the peer-to-peer interview (i.e., two interviews). This tool affords educators, evaluators, and/or researchers a way to gain personal insights and stories from youth that cannot be captured through a survey. We suggest peer interviews as youth may be more comfortable speaking with someone of their own age than an adult. It also saves time in conducting one-on-one interviews with youth and empowers youth as participatory researchers. We suggest you model how to interview someone first. We also suggest that the interviews be audio-recorded for further reflection and be conducted in a location with little noise. Many devices have audio recording features. Again, this protocol can be used in conjunction with the observation protocol.

Asterisks in the interview protocol are questions to include in the peer-to-peer interview if time is a factor.

Peer Interview Protocol

Your goal is to interview a friend about a recent design problem and/or investigation. It is important that you listen to your friend and do not interrupt. Also, if their reply is too short, ask them to explain with more details.

1. *Explain the goal of the problem and/or investigation.

2. How did you use math? Give me an example.

3. What type of research did you do to help with the problem and/or investigation?

    a. How did this help?

4. *Did you draw or build a model before starting? Why or why not?

5. What tools and material did you use?

    a. Which tools and materials worked well?

    b. Which tools and materials did not work so well? What did you do?

6. *Tell me about one failure you experienced.

    a. What did you do after this failure?

7. Would say that you kept going when things did not work as expected? Why or why not?

8. *Tell me how you worked with other people.

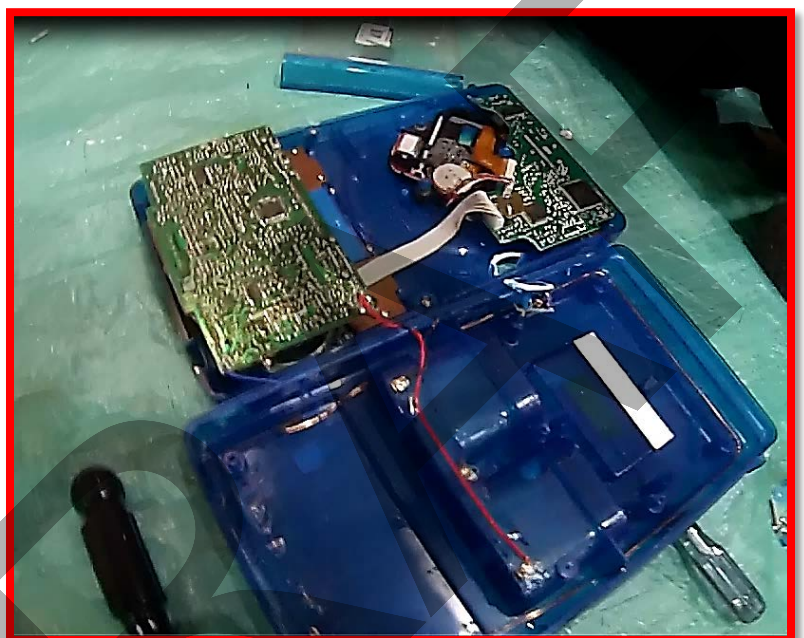
    a. Did you provide suggestions to someone on how to improve and/or change their design? Tell me about this.

9. How did you present your final product and design solution to other people?

Reflective Tweet Post-It Wall

The purpose of this tool is to assess youth's engagement as a STEM professional and/or within one of the practices (e.g., Attend to Precision) through setting up a blank spot on a wall for youth to post a response to a question (e.g., How did you engage as an engineer in this activity?).

Reflective Tweet Post-It Wall can be used throughout a making activity and lends itself well to short drop-in making contexts. Location on the wall should be visible for youth to see. Youth should also be able to access the wall easily and safely. The information to be gained from this tool will be less than that of the other tools in this suite. However, this tool can complement the others.



Reflective Tweet Post-It Wall

Set up a blank spot on a wall for youth to post a response to a question. You will need to have plenty of post-it notes and writing utensils.

Directions for youth: In 280 characters or less, post a twitter message to the following question: ____ Don't forget to create a hashtag (e.g., #EngineersRock)

Potential Questions:

- How did you engage as an engineer in this activity?
- How did you engage as a technologist in this activity?
- How did you engage as a scientist in this activity?
- How did you engage as a mathematician in this activity?
- Describe your approach in _____.
- What real-world problem can be solved using similar material and tools.
- What question do you still have after completing the activity?
- Did you brainstorm plans and ideas with someone else before starting? Why or why?
- What was your goal for this activity?
- Explain how you used measurement in this activity.
- What did you do when something went wrong?
- Describe one change you made to your design.
- What improvements would you make to your design if you had more time?
- Write an advertisement for your final product.
- Did you have to conduct research? Why or why not?
- How did your design meet the demands of the activity?

Sorting responses: Consider sorting the responses into three different levels:

- Low sophistication: Response does not answer the question posed. OR Response was vague and could be a response of ANY activity.
- Medium sophistication: Response is specific to the activity, but lacking detail.
- High sophistication: Response is specific to the activity. Provides evidence to support response.

Example: "Write an advertisement for your final product."

- Low sophistication: Buy me.
- Medium sophistication: I am the best scribble bot.
- High sophistication: If you are looking for a robot than can draw circles in a variety of colors, then I am the toy for you. Only $24.99 at select stores.