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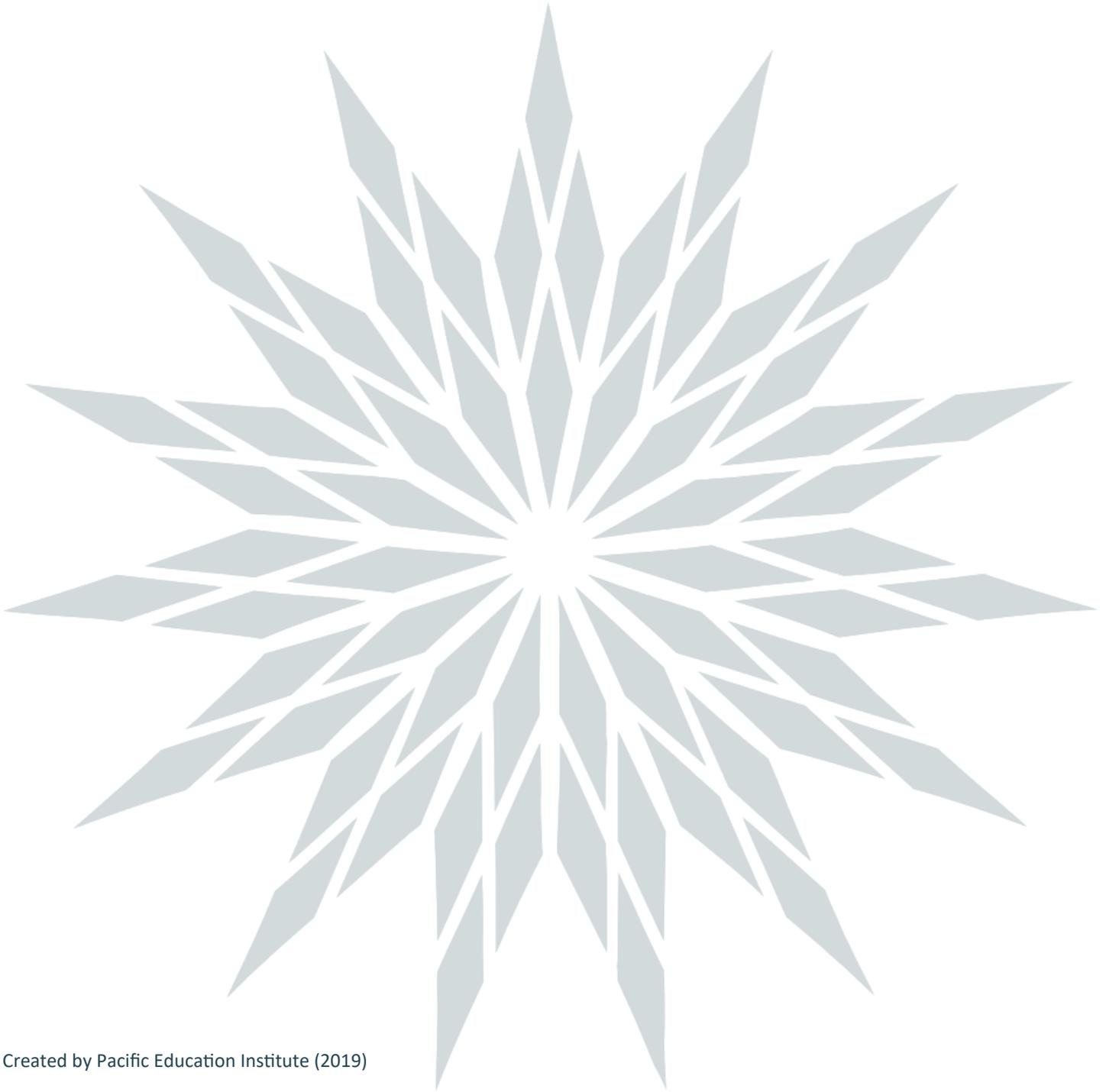
## **FieldSTEM Science Notebooks:**

**A supplement for implementing notebooks to promote the development of ELA and math skills, scientific reasoning and social competency**



**Pacific Education Institute (2019)**

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Created by Pacific Education Institute (2019)

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Writing and editing support provided by: Kathryn Kurtz, Denise Buck, Lori Reynolds and Heather Sisson. Design: Katie Hatam

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## Why Science (FieldSTEM) Notebooks?

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PEI promotes FieldSTEM: a model of instruction where traditional content areas are integrated to help students apply their learning in their communities. FieldSTEM notebooks are an instructional tool where students' ELA and math skills are utilized in service of developing student understanding about complex social and ecological questions, problems, issues and opportunities. FieldSTEM notebooks have many benefits. They provide a space for teachers and student to track students' thinking and practices - preparing them to be a part of the 21st century workforce, they provide opportunities to increase collaborative communication skills, and provide a vehicle for differentiated instruction.

To help develop globally competitive students, FieldSTEM notebooks provide a place for students to record observations and reflect on the evidence from their field investigations. Notebooks encourage active learning and provide opportunities for students to pursue their own interests and tackle authentic problems (Hargrove & Nesbit, 2003; Gilbert & Kotelman, 2005). With lessons that bridge relevant content, this evidence can be used to engage students in collaborative inquiry as a way of learning content, connecting students' thinking and experiences with concepts, and providing opportunities to challenge students, to push their thinking further. Educators must resist the temptation to provide pre-made scaffolds for students, like worksheets and data charts, and instead encourage students to embrace their need to learn and grow in their skills. Students will learn to develop effective tables for data collection only if they are allowed to struggle with the number of rows and columns and how to label them. Ultimately, opportunities like these provide students with the skills to think critically and make informed decisions.

A FieldSTEM notebook becomes real evidence of student learning and thinking, and a tool to shape future productive citizens. FieldSTEM notebooks can promote communication between students, teachers and parents or guardians by providing evidence of a student's conceptual understanding and personal reflections providing evidence for student-driven parent conferences where both student and parents or guardians are engaged with the material. It becomes a way of capturing common and individual experiences on paper where they won't get lost and where they can be referred to as needed to drive discourse. By providing student-friendly sense making tools, rubrics, feedback, scaffolding and modeling along with release of responsibility—a process where a teacher encourages and supports learners to design and monitor their own learning around classroom goals—this same evidence can be used by students to self-assess their growth in understanding or their capacity for doing. FieldSTEM notebooks expose students' thinking, providing important insights about student understanding and serving as formative assessment tools (Hargrove & Nesbit, 2003; Gilbert & Kotelman, 2005). This concrete record of reflection, assessment, and connection can be viewed and discussed by teachers who can gain an understanding of a students' thought process, sense-making and patterns across a classroom to modify instruction.

Providing opportunities for all students requires instructional strategies that ensure equity of access. Using modeled scaffolds (graphic organizers, writing frames, etc.) in conjunction with a gradual release of responsibility toward learner independence, FieldSTEM notebooks promote the development of ELA and math skills, scientific reasoning and social competency. Abstract concepts in content areas, when connected to hands-on experiences, where evidence is recorded in the FieldSTEM notebook, provide emergent readers and writers with an effective tool that allows them to increase proficiency in accessing FieldSTEM in the world around them by using ELA and math successfully. Notebooks provide a structure and support for differentiated learning, helping all students to achieve (Amaral, Garrison, & Klentschy, 2002; Gilbert & Kotelman, 2005). Strategies to help implement FieldSTEM notebooks can be found in this supplement.

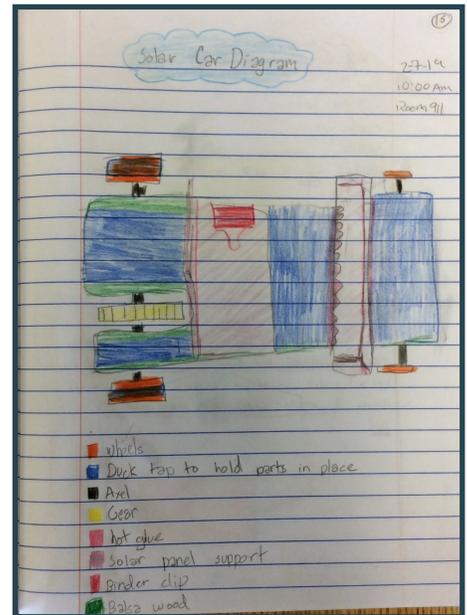
## Guidelines for Setting up a FieldSTEM Notebook

### Materials needed every time you teach FieldSTEM in the classroom:

- Notebook (have a place to keep notebooks in the classroom)
- Color pencils/crayons (color helps the brain learn and remember)
- Glue/scotch and packing tape (to secure important data, foldables, data sheets, graphs that are essential to the learning experience)
- Highlighter (for highlighting important ideas)
- Post it notes (for collaborative conversations)

### Getting Set up:

- At the start of the year, discuss how FieldSTEM will be incorporated into their learning and encourage students to decorate the cover over the course of the study. Have them select one image to add during week one (covering with packing tape will help keep it down)
- Number the pages in the bottom right hand corner (encourage students to write really small)
- Page 1: Ensure students write their names on both the cover and on the Title page
- Page 2: Collaborative Community contract, glued in after students sign the contract
- Pages 3-6: Table of Contents (with support and modeling by the teacher, students list the date, title, and pages of each experience)
- Select 4-6 pages at the end for the Glossary
- For stronger notebooks: Open notebook to the center stapled page. Slide in a rubber band (size 3 1/2 x 1/16 works well), binding the pages to the front cover. Close notebook.
- Reinforce the spine of notebook with packaging or duct tape.



### Key Final Thoughts:

- Make the FieldSTEM Notebook design work for you and how you structure your classroom.
- Model FieldSTEM Notebook use for your students.
- To the extent possible have students create their own forms, tables, graphs etc. and differentiate with pre-made sheets as necessary.

## FieldSTEM Notebook Strategies

Using modeled scaffolds (graphic organizers, writing frames, etc.) where there is a gradual release of responsibility toward creating these independently, FieldSTEM notebooks promote the development of English language arts and math skills by utilizing them in service of engaging, locally important problems, issues, questions and opportunities.

While FieldDesign provides templates for organizing student work, educators must resist the temptation to provide pre-made scaffolds, worksheets, data chart, etc. for students and instead encourage students to embrace their need to learn and grow in their skills. Students will learn to develop effective tables for data collection only if they are allowed to struggle with the number of rows and columns and how to label them. Ultimately, opportunities like these provide students with the skills to think critically, work and communicate in collaborative ways and make informed decisions on behalf of their community.

There are many strategies to engage students in utilizing their FieldSTEM notebook. A few are listed here. PEI readily admits these strategies have been used in classrooms for decades and called many things, we offer them here as examples of ways to utilize FieldSTEM notebooks.

## Notebook Strategy: Developing Student Thinking

At PEI we promote students' sense of wonder. The following Left Side/Right Side FieldSTEM notebook strategy will encourage this sense of wonder while simultaneously developing student thinking. In a FieldSTEM notebook, you would model:

<b>LEFT SIDE</b> <b>Output</b>	<b>RIGHT SIDE</b> <b>Input</b>
<p>Student generated entries on this side demonstrate understanding of the information on the right side, focuses attention, guides student learning of content and concepts, and are a good resource for student created investigations and focus questions. Every left side page gets used. Entries can include:</p> <ul style="list-style-type: none"><li>• brainstorming</li><li>• self reflection</li><li>• photos</li><li>• illustrations</li><li>• models</li><li>• diagrams</li><li>• poems</li><li>• concept maps</li><li>• songs</li><li>• design process ideas</li><li>• questions</li><li>• wonderings</li><li>• mapping</li><li>• flow charts</li></ul>	<p>Information from other sources including teachers, texts, observations from activities. Entries on this side are connected to learning goals, capture content, ideas and evidence for future reference, provide assessment and feedback opportunities and drive instruction. Entries can include:</p> <ul style="list-style-type: none"><li>• focus question</li><li>• mapping</li><li>• field investigation notes/data</li><li>• vocabulary</li><li>• speaker, text or video notes</li><li>• lab activities</li><li>• entry types, data tables</li><li>• date, time, location, weather</li><li>• diagrams, comparisons</li></ul>

## Notebook Strategy: Collaborative Communication

Evidence of a student's conceptual understanding can be communicated by assessing the student's thinking, skills and understanding of content in their FieldSTEM notebook. Look for evidence of these elements and others in what they've captured in their entries. Utilizing the Next Generation Science Standards evidence statement for any given performance expectation may be useful. Engage in collaborative conversation around the entries: teachers and other students who have been coached on constructive feedback can provide input on a "post it note" or verbally. Strengths should point to specific information and examples and how they meet the criteria/evidence statements. Weaknesses should be addressed in the form of a question that a scientist or an engineer would ask, such as: "Do you think another engineer would need more information to understand?"

An effective collaborator will eliminate vague feedback like "good job" and use questioning strategies. A sample of FieldSTEM notebook entry questions that help a collaborator understand and move another person's thinking forward are:

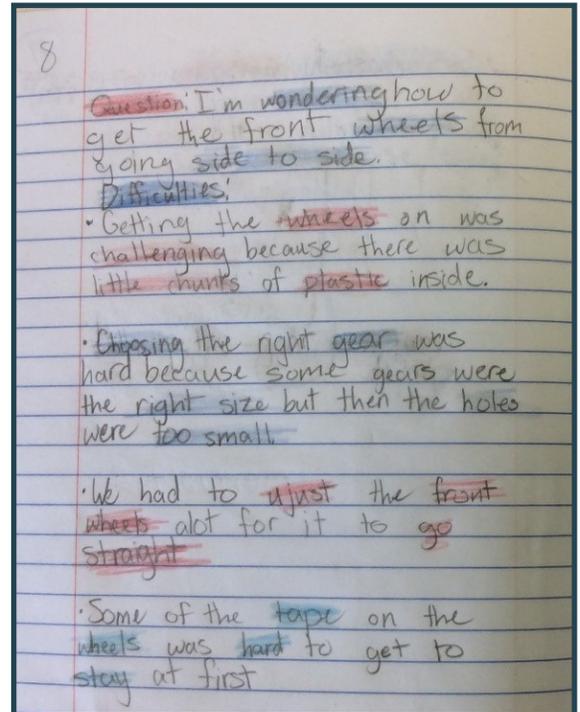
- What did you observe that makes you think that?
- What evidence do you have to support your thinking?
- Have you recorded your evidence accurately?
- Do your results support your prediction? If not, how has your thinking changed?
- Are there people in the community that would agree with this thinking?
- What do you think happened during your project that led to inconsistent or inconclusive data?
- Have you reread your entry to see if any changes are needed to make it more clear or accurate?
- What are your next steps?

## Notebook Strategy: Sentence Frames for Differentiated Instruction

To help students become independent writers it is important to model how to organize the thinking and evidence they capture in their FieldSTEM notebooks. With consistent modeling and support and then a gradual release of responsibility with writing frames, you are providing a tool for emerging writers that allows students to use ELA skills successfully to access STEM in the world around them and share their thinking with others. These frames can be used for sharing evidence verbally as well. Simply post the phrases in a pocket chart or on a bulletin board then model and practice their use.

### FieldSTEM Notebook Writing Frames

Observations:	I observed _____.
Compare:	A _____ has _____ and _____. A _____ has _____ and _____. Both have _____.
Contrasts:	_____, but _____. At first, _____, but now _____.
Sequence of Time:	First, _____. Next, _____. Then, _____. Finally, _____.
Predicting:	I predict that _____ will _____ because _____.
Cause and Effect:	_____ because _____. If _____, then _____, so _____.
Reasoning:	I think _____, because _____. At first, I thought _____, because _____. Now I think _____, because _____.
Conclusions:	For the following reasons _____, and _____, I think _____.
Claims and Evidence:	I think _____ because _____. If you do _____ then _____ because _____.



## Notebook Strategy: Activating Prior Knowledge and Preconceptions

Goal: To help students identify what they have already experienced or observed about the topic and to make connections.

Capture student thinking:

- On a O.W.L. chart or another graphic organizer
- Individually, in groups, or as a whole class
- Sparked by a different content area connection (i.e. poetry or art on the topic)

Possible prompts:

- What does (project topic or term) make you think about?
- Have you \_\_\_\_\_ before?
- What do you think about when you look at ...?



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