A Guide to PEAR’s STEM Tools:
Common Instrument Suite &
Dimensions of Success

The PEAR Institute:
Partnerships in Education and Resilience

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Introduction

The PEAR Institute: Partnerships in Education and Resilience creates and fosters evidence-based innovations in socio-emotional learning (SEL) and Science, Technology, Engineering and Math (STEM) so that increasingly “young people can learn, dream, and thrive.” PEAR is located at McLean Hospital in Belmont, MA and is affiliated with Harvard Medical School. Over the last 15 years, The PEAR Institute has evolved into a recognized translational center that adapts research findings into practices for schools and afterschool programs. PEAR is delighted to work with you to help ensure that children have positive, high-quality experiences when they participate in OST STEM activities.

PEAR has developed two widely used tools: a self-report survey for students called the Common Instrument Suite (CIS) and a program quality observation tool called Dimensions of Success (DoS). Together, these tools form the PEAR STEM Toolkit. This document provides an overview of these tools and the next steps for how to use the tools to improve your students’ OST STEM experience!

Common Instrument Suite (CIS)

The Common Instrument Suite (CIS) is a self-report survey that measures a variety of science-related attitudes, including STEM interest, STEM career knowledge, and STEM identity. It was specifically developed with informal/outside-of-school time (OST) STEM programs in mind. The purpose of the survey is to better understand how informal STEM programming impacts students’ perceptions/attitudes towards STEM.

Thanks to funding from the Noyce Foundation (now STEM Next at the University of San Diego), the original Common Instrument (CI) was developed in 2009 by Dr. Gil Noam (director of PEAR) and OST practitioners and educators from major organizations like Girls Inc. and 4-H. It has been administered over 30,000 times to students enrolled in informal science programs across the U.S., and it has shown strong reliability in previous work (alpha’s > 0.85).

PEAR is now working to expand the original CI survey to include other important indicators inspired by the internationally recognized Program for International Student Assessment (PISA) and Holistic Student Assessment surveys (HSA).

- The PISA-related items measure how knowledgeable and interested students are in obtaining science careers, how intrinsically motivated students are to be involved in science-related activities, and how much students enjoy performing and learning about science.

- The HSA assesses 21st century skills that are highly correlated with interest and achievement in science, particularly perseverance, critical thinking, and relationships with peers and adults.

The CIS typically takes 10 minutes or less to complete, but this may vary depending on the number of outcome measures included on the survey and the type of survey design used. The following table
shows all of the possible outcome measures that can be included on the CIS survey, but the PEAR Institute will work with you to customize a survey that will meet your evaluation goals. We also take into account the age of your students and the duration of your STEM programming.

<table>
<thead>
<tr>
<th>Outcome Measures for the CIS</th>
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<tbody>
<tr>
<td><strong>STEM-Related Attitudes</strong></td>
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<tr>
<td><strong>STEM Interest</strong></td>
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<td><strong>STEM Identity</strong></td>
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<tr>
<td><strong>STEM Career Interest</strong></td>
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<tr>
<td><strong>STEM Career Knowledge</strong></td>
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<td><strong>STEM Enjoyment</strong></td>
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<td><strong>STEM Activities</strong></td>
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<td><strong>21st Century Skills / Socio-Emotional Learning (SEL)</strong></td>
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<td><strong>Relationships with Adults</strong></td>
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<tr>
<td><strong>Relationships with Peers</strong></td>
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<tr>
<td><strong>Perseverance</strong></td>
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<tr>
<td><strong>Critical Thinking</strong></td>
</tr>
</tbody>
</table>

In addition, we offer three types of survey designs: (1) traditional pre-test/post-test, (2) retrospective change, and (3) retrospective pre-post. The survey items are the same across these designs, but the framing of the questions differ to allow for students to think about the items from different points of view.

1. The **traditional pre-test/post-test** method is the most widely-used design, and students are asked to complete the survey twice: once at the beginning of the program and once at the end of the program. Change is measured by subtracting pre-test scores from post-test scores. This survey is typically on a 4-pt Likert Scale from “Strongly Disagree” to “Strongly Agree.”

2. The **retrospective pre-post** method is similar to a traditional pre-test/post-test because students answer each question twice from two different frames of reference: “before the program” and “at this time,” respectively. However, the survey is only administered once at the end of the program, and students provide ratings for “then” and “now” during the same administration. This survey is typically on a 4-pt Likert Scale from “Strongly Disagree” to “Strongly Agree.” The response scales are presented on the left and right sides of the page (i.e., “Before Program” and “At this Time”) with the survey items in the middle.

3. The **retrospective change** method also asks students to reflect on how much they feel they have changed, except that the survey is only administered once at the end of the program and students only need to answer each question once. More specifically, students are shown a sentence and are asked to think back to the beginning of the program and rate whether they do/feel things less or more because of the program. This survey is typically on a 5-pt Likert Scale from “Much Less Now – About the Same – Much More Now.”
Factors to Consider

To be sure the CIS survey is appropriately customized for your program, there are a number of factors for you to consider:

**What is the age/grade of your students?**
- The CIS is recommended for Grades 4 and above. For programs with younger students, we strongly recommend a read-aloud protocol (either one-on-one or in small groups).

**Will you need the survey to be translated into another language?**
- The CIS is available in English and Spanish. Other translations may be available upon request.

**Does your program have a specific STEM focus?**
- The CIS uses the word “science” generally, however, we can customize the survey for programs with specific STEM focuses. For instance, if you are a math program, we would substitute the word “science” for “math” where possible/appropriate.

**How will you administer the survey?**
- The survey is available in PDF to print, or we can create survey links to access the survey online using an electronic device with reliable internet access. We encourage programs to administer the survey electronically when possible – it helps you avoid a lot of data entry and shortens the data processing/reporting time!

**How often do can you administer the survey?**
- The pre-test/post-test design requires two administrations, whereas the retrospective change and retrospective pre/post designs require only one administration. If staff time or teaching time is limited, you may prefer to use one of the two retrospective options. The retrospective designs are also strongly recommended for programs with less than three weeks of STEM activities.

**Which survey design do you want to use?**
- There are pros and cons for every survey design. The traditional pre-test/post-test design has the advantage of being the most widely used design, and it allows you to establish a baseline of how students are feeling about science before they experience your program. On the other hand, the pre-post design requires more time and is prone to a phenomenon called “response shift bias.” This typically occurs after students have participated in the program and the students’ perception of themselves has changed due to their experience in the program – which frequently results in neutral or negative outcomes even if the students felt they learned a lot! The retrospective designs avoid this response-shift bias, however the concept of reflecting back and thinking about change can be cognitively challenging for younger students, and thus we recommend the retrospective designs for older students (middle school-age and up).

**How much will it cost to use the survey or consult with the PEAR Institute?**
- Please contact the PEAR Institute for more information. There may be costs for requests that are above standard services (e.g., data entry assistance, project coordination/management, webinar or other trainings, advanced data analysis such as multi-year reporting, extensive
customization or use of non-PEAR surveys with CIS) or when the scope of the project is very large (e.g., multiple programs/sites, large number of students being evaluated).

**What else does PEAR use our data for?**

- PEAR de-identifies all data and adds it to a growing database. This allows us to establish national norms and to inform on national trends in OST STEM education.

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**Next Steps to Use CIS**

Once you have decided upon the factors mentioned above, you should contact the Research Department at the PEAR Institute and set up a phone conversation (see contact information on the last page of this document).

**Roles of the program:**

- Your program staff will work with PEAR to devise a survey that will best meet your evaluation goal(s).
- Your program staff will take the lead in managing survey administration and data collection at your schools/sites.
- Your program will determine whether parental consent (passive or active) is required.
- Your program staff will assign student IDs (when necessary, such as pre-post designs).
- Your program staff will enter paper/pencil surveys unless if you administer them electronically.

**Roles of the PEAR Institute:**

- Our team will work with you to decide on the right survey items, format, and design.
- Our team will create PDF files and/or survey links so that you can easily administer the survey.
- Our team will process your program’s de-identified data and perform statistical analyses.
- Our team will return to you a report with your program’s unique results within 7 business days.

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**CI/ CIS Reports**

PEAR will compare your program’s data to our national database so you can understand how your students compare to students in the informal STEM universe. The data report you will receive is typically in the form of a PowerPoint file or an Excel Dashboard.

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*For more information about using the PEAR Common Instrument Suite, please contact Becky Browne, STEM Client Relationships Coordinator at 617-484-0466 or rkbrowne@mclean.harvard.edu*
Dimensions of Success (DoS) is an observation tool that measures the quality of students’ STEM learning experiences in informal/out-of-school time (OST) settings. DoS defines twelve indicators of quality and the tool includes a 4-level of quality for each dimension. Currently, some observers are piloting its use to examine STEM experiences during the school day as well.

PEAR developed and studied the DoS tool with funding from the National Science Foundation, along with partners at Educational Testing Service (ETS) and Project Liftoff for the past six years.

The twelve dimensions fall in four broad domains: Features of the Learning Environment, Activity Engagement, STEM Knowledge and Practices, and Youth Development in STEM.

The first three dimensions look at features of the learning environment that make it suitable for STEM programming (e.g., do kids have room to explore and move freely, are the materials exciting and appropriate for the topic, is time used wisely and is everything prepared ahead of time?).

The second three dimensions look at how the activity engages students: for example, they measure whether or not all students are getting opportunities to participate, whether they are doing activities that are engaging them with STEM concepts or something unrelated, and whether or not the activities are hands-on, and designed to support students to think for themselves versus being given the answer.

The next domain looks at how the informal STEM activities are helping students understand STEM concepts, make connections, and participate in the inquiry practices that STEM professionals use (e.g., collecting data, using scientific models, building explanations, etc.).

Finally, the last domain assesses the student-facilitator and student-student interactions and how they encourage or discourage participation in STEM activities, and whether or not the activities make STEM relevant and meaningful to students’ everyday lives, and the experiences. Together, these twelve dimensions capture key components of a STEM activity in an informal afterschool or summer program.
Factors to Consider for Quality Observations

DoS can be used in two important ways. It can be used as a self-assessment observation tool for STEM program administrators and staff so they can understand the strengths and weaknesses in their programming. DoS can also be used by external evaluators or funders to track quality in programs over time and/or quality across a city or a state.

Programs can choose to be observed by either internal staff or external evaluators who are trained and certified to use the tool. While all staff at a site may not have time to become fully certified DoS observers, they can still learn to plan for high quality using the DoS dimensions. See our DoS Program Planning Tool here: http://pearweb.org/tools/dostool.html

If you are planning to use DoS, there are several items to consider:

What are your goals for assessment/evaluation?

- Do you want to help your program or the programs in your state/organization/region pinpoint their strengths and weaknesses?
- Do you want to compare and contrast quality across programming at different sites of an organization (e.g., Boys and Girls Clubs or YMCAs)?
- Do you want external evaluators to use DoS to report quality across the state?
- Do you want to collect internal scores about the quality of your STEM activities so you can reflect and improve with your staff?
- Do you want to understand the strengths and gaps across an entire state network or region and analyze patterns for system-level decision making (Mott Networks)?

Who will be using DoS and how often?

- Do you want staff at each site to observe each other’s lessons? How often will they observe?
- Do you want program leaders to observe each site twice?
- Do you want state representatives from the STEM board to visit each site in Fall and Winter?

What will you do with the data?

- Will ratings be discussed internally with staff?
- Will you be reporting ratings to funders?
- Will you request and discuss quarterly reports (created by PEAR)?
- What type of comparisons/analyses do you hope to conduct (i.e. Module Reports, Regional Reports, or State wide Reports)?
- Do you want to connect observation data (DoS) with outcome data? Do you want to compare curricular units, particular age groups, or facilitators? DoS can be used in customized ways, so think about the story you want to tell with the data, and PEAR will consult with you to come up with the best plan for your individual needs.
DoS Reports

**Average Scores for Region 1**

<table>
<thead>
<tr>
<th>Category</th>
<th>Fall</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Materials</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Space</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Participation</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Purposeful</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Engagement</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>STEM</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Inquiry</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Reflection</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Relationship</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Relevance</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Youth Voice</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

PEAR will provide quarterly reports upon request. PEAR will work individually with clients to decide how to analyze the DoS data in a way that is most meaningful to the Program. Our most common reports break down DoS data by time, location, and/or module.

**Next Steps to Use DoS: Certification**

To use DoS, a potential observer must complete the entire certification process – a total of four steps.

1. Trainees must attend a 2-day training (in-person or online) to learn how to define and observe quality in each dimension.

2. Trainees will complete a set of video simulation exercises to practice their understanding of the tool. PEAR will then review each trainee’s ratings and evidence, and will provide individual feedback.

3. At a one-hour calibration session (phone conference), PEAR trainers will address any questions from the video exercises and will provide additional examples to help clarify the use of the tool.

4. Trainees will then arrange to practice using DoS in the field at afterschool sites in their local area. This step allows trainees to use the tool in the field and to incorporate any feedback they received on the video simulations to their observations. Trainers can also catch any possible struggles a trainee may be having with the tool. This will allow the trainers to work with trainees to fix these issues before certification.

Upon successful completion of all these requirements, observers will be DoS certified for 2 years and can use the tool as often as they would like during that period. After 2 years, re-certification is needed to continue to observe and collect data with DoS.

For more information about The DoS Observation tool and certification, please contact Rebecca Browne, STEM Client Relationships Coordinator at 617-484-0466 or rkbrowne@mclean.harvard.edu
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