Carnegie Foundation
for the Advancement of Teaching

# Introduction to Improvement Science: A Learning-by-Doing Simulation
## Overview of the Experience by Section, with section objectives

**Workshop description:**
Using a case-based simulation that mixes instructional lessons with guided, hands-on teamwork, participants in this workshop will advance their understanding of how improvement science can enhance the capacity of classrooms, schools, districts, and other institutions to produce high-quality outcomes reliably for every child across diverse settings. Participants will experience being part of an improvement team at key stages: investigating the problem, articulating a focused aim, identifying changes, and working through Plan-Do-Study-Act (PDSA) cycles to test and learn from those changes. Participants also reflect on the personal dispositions that support effective improvement work. From this interactive session, participants will learn how a multi-month improvement journey can build and take shape.

At the end of the workshop, participants will be able to:

- Understand on a basic level what it feels like to apply improvement science approaches to solving educational problems, including:
    - The social aspects of improving in teams and organizations
    - Improvement science as a nonlinear and creative problem-solving process
- Describe some of the basic methods, tools and processes of improvement science in education, based on their experience
- See how the utilization of improvement science tools can provide insights into answering questions about root causes of disparate results in education and into solving educational problems
- Identify and appreciate the various skills and capacities required to do improvement work in educational contexts.

After participation, attendees will be more likely to…

- Pursue additional learning in improvement science.
- Make informed decisions about the appropriate application of Improvement Science in their context

The workshop is divided into six sections, each of which includes mini-lessons on core improvement ideas as they become important for specific activities.

**Section 1: Simulation Introduction**
**Section 2: Understanding the Problem and the System**
**Section 3: Focusing Collective Efforts and Building Theory**
**Section 4: The PDSA Cycle**
**Section 5: Change Bundles and Degree of Belief**
**Section 6: Reflection and Closing**

Detailed descriptions of each section follow.

# Simulation Introduction

| Time | Objectives | Materials |
|---|---|---|
| 25-30 min | Participants will understand…<br>• The structure of the simulation experience<br>• Advantages and limitations of working through a simulation<br>• Improvement projects are borne out of dissatisfaction with the status quo<br>• Improvement is a learning journey<br><br>Participants will be able to…<br>• Use a protocol to structure a data conversation | Initial data display (1a)<br>Role name tags (2a) |

**Summary:**
**Mini-Lesson:** What is Improvement Science?
Participant take-away: Improvement Science is a methodology that is used in industry and healthcare, and which the Carnegie Foundation is helping to bring to the education sector. Improvement science responds to dissatisfaction with the status quo, and combines management theory, specific tools, and habits of mind for tackling improvement problems.

**Activity:** Data Protocol
Participant take-away: Data is an important tool for understanding a problem as it plays out in context. Data protocols allow groups to generate shared understanding, and to leverage different perspectives to more deeply understand the data. Data analysis should always begin with making descriptive statements to check that people are reading the data in the same way before shifting to interpretive statements. Data can be presented in different ways to answer different questions.

**Narrative description:** In the opening of the session, you (the facilitator) set up a journey that the group will take together over the next several hours. The simulation is based on the lived experience of a real school, with minor modifications so that a multi-year journey can be shared in the span of a few hours and also to ensure the content is accessible to those outside of the specific school context. You should set participant expectations for this session by explaining the structure of the workshop (a fast-paced mix of mini-lessons and hands-on simulation activities) as well as by pointing out that some activities may feel artificial or contrived because it is, in fact, a simulation and not the participant's authentic context.

After explaining the structure of the workshop, briefly define improvement science and networked improvement communities, and then move rapidly to putting participants into the school context of the case study. This section of the simulation concludes with exploring the case study school data and helping participants experience a data protocol which serves to focus all participants on the specific improvement problem for this particular case of chronic absenteeism.

# Understanding the Problem and the System

| **Time:**<br>40 min | **Objectives**<br>Participants will understand…<br>• The definition of a system and systems thinking<br>• The importance of thoroughly investigating the problem and the system that produces it prior to moving toward solution.<br>• How an improvement team might use different tools to see the system from different angles and to expand understanding of the problem and the system<br><br>Participants will be able to…<br>• Synthesize learning about a system from an artifact of investigation.<br>• Participate in an affinity protocol to surface learning and identify commonalities. | **Materials:**<br>Data packets by role (2b, 2c, 2d, 2e)<br>3”x3”sticky notes<br>pens/pencils<br>Affinity protocol mat (2f)<br>Fishbone diagram (2g) |
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**Summary:**
**Mini-Lesson:** Systems and Systems Thinking
Participant take-away: Taking a systems view is an important part of improvement science. Because the systems we work in are complex, we can each only see the part of the system to which we are most closely connected. Understanding the system more robustly through investigation helps us understand the root causes of the problem we are trying to address.

**Activity:** Problem investigation and Affinity Protocol
Participant take-away: A variety of improvement tools help groups to surface different experiences and views of the system, visualize processes that are part of the problem and the system, and investigate variation. As teams divide up investigation it is critical that they also regroup and consolidate their learning.

**Narrative description:** This section of the workshop introduces a graphic organizer of the typical phases of an improvement effort. You can use the, “What’s Next?” organizer, which we at Carnegie often refer to as the “Improvement Science Cheat Sheet,” to signal a transition to a different phase of the improvement journey as you move through the simulated effort to improve chronic absenteeism. (For more on the “What’s Next” organizer, please see “Common conventions of this workshop”, in the full handbook.)

After introducing the graphic organizer, this segment continues with a mini-lesson about understanding the problem and the system that produces it. The mini-lesson introduces four tools often used in improvement science for investigating a problem and a system: empathy interviews, process maps, looking at data using a variety of visualizations, and scanning and using research. After introducing each tool you will move teams into a simulation activity for

understanding the problem. Participants will be assigned an artifact of one tool to examine, based on their role. Participants will work in role-alike groups to extract key learnings about the problem. Then, individuals will report back to their teams and use an affinity protocol to synthesize learning.

The section closes with a warning about balance: that while it is critical to investigate before jumping to a solution, it is equally important not to get paralyzed in the analysis phase of the work.

## Focusing Collective Efforts and Building Theory

| **Time:**<br>30 min | **Objectives**<br>Participants will understand…<br>• The role of an aim statement in focusing collective efforts in an improvement project.<br>• The role of a theory of practice improvement (represented in a driver diagram) to organize learning in an improvement project.<br><br>Participants will be able to…<br>• Generate ideas for change based on their analysis of the system and their role in the simulation.<br>• Articulate how an individual change idea relates to the improvement aim and the larger theory of practice improvement. | **Materials:**<br><br>Large format Driver Diagram (3a)<br>Sticky Notes |
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**Summary:**
**Mini-Lesson:** Aim statements
Participant take-away: Aim statements are important tools for focusing efforts and defining an improvement project. They are specific about what will be improved, by how much, by when, and for what or whom.

**Mini-Lesson:** Theory of Practice Improvement & Driver Diagrams
Participant take-away: A Theory of Practice Improvement articulates the aim, select drivers that the team hypothesizes will impact progress towards the aim, and specific change ideas aligned to those drivers. It is a working theory that evolves and changes to reflect learning through testing.

**Activity:** Brainstorm change ideas and articulate hypotheses
Participant take-away: Specific change ideas are aligned to drivers in the theory of practice improvement. Read right-to-left, one branch of the driver diagram illustrates a hypothesis of how an individual change idea will impact progress towards the aim.

**Narrative description:** As teams pivot from problem investigation to action, they focus their collective work by articulating an aim statement and a theory of practice improvement. In the simulation, participants consider the technical and motivational qualities of an aim statement before being presented with the aim that will organize their efforts going forward.

Improvement teams have now narrowed their focus within the broader problem area of "absenteeism," and shift to looking at how they will go about working on the problem. Because improvement science is a kind of **theory-based learning**, we pay explicit attention to naming what actions we take and how and why we anticipate our actions contribute to our desired outcomes. In the simulation, this process of developing a theory begins with identifying key levers for change from the problem and system investigation. After introducing the four drivers that will focus efforts towards the aim, it is time to brainstorm change ideas.

After a mini-lesson about where **change ideas** come from, participants generate some ideas for change based on the research and discussion they completed earlier in the simulation. Participants practice articulating those ideas as a theory of change and they fit their ideas into the driver diagram.

You will notice the simulated journey moves back and forth between "focusing collective efforts" and "generating ideas for change" on the "What's Next" organizer. This is common in an improvement journey, and this session is a useful moment to point out the non-linear, or cyclical, nature of improvement science. Also emphasize that learning at any stage of the journey can inform the theory being developed.

## The PDSA Cycle

| **Time:**<br>50 min | **Objectives**<br>Participants will understand…<br>• How a Plan-Do-Study-Act (PDSA) cycle structures learning.<br>• The role of predicting in testing a change.<br><br>Participants will be able to…<br>• Record predictions in a PDSA form and collect observational data to check those predictions.<br>• Determine whether to adapt, adopt, or abandon a change idea based on data from a test. | **Materials:**<br>Family Meeting Protocol (4a)<br>Standard PDSA Form (4b)<br>Large format PDSA Form (4c) |
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**Summary**

**Mini-Lesson:** Testing using a PDSA Cycle
Participant take-away: The four steps of a Plan-Do-Study-Act cycle work together to structure learning. Each step is necessary to complete the learning cycle. It is critical to make and record predictions in the "plan" phase in order to reflect and recognize learning in the "study" phase.

**Activity:** Run a PDSA on a family meeting protocol
Participant take-away: Making predictions and identifying the data to collect to check the prediction is critical in the PDSA process. Drawing on evidence to determine learning and next steps in the "study" and "act" phases requires discipline. Changes are refined over multiple PDSA cycles.

**Narrative description:** The simulation now shifts from how to generate and organize a range of ideas to figuring out how to test a single idea and collect evidence of improvement. This is significant jump forward in time from the previous section, and a number of actions would have taken place that we have skipped over in the simulation. In this fast forward, a team would have made sense of what they now understand about the problem and about their current data to generate their theory of improvement. They would have organized that understanding as well as ideas for potential changes to arrive at a first version of the driver diagram, and may have identified a first change idea to test. Acknowledge all that has happened in the time you've skipped over so that participants can better understand the arc of the journey.

In this part of the simulation, you are going to introduce the **Plan-Do-Study-Act** cycle, emphasizing the importance of prediction in the Plan phase to fuel learning. After you introduce the cycle in the simulation, participants will have a chance to try a PDSA. You will have a group role play a family meeting. Once participants have made predictions about what they'll see in the role play based on a particular protocol, they then observe the meeting, reflect on what they saw and decide what to do next with their change.

We perhaps overdesigned how the PDSA might play out in an effort to ensure participants have an opportunity to draw some conclusions in the context of the cycle in a highly scaffolded environment. You might remind participants at this section that the experience may feel contrived, designed to help people try out the PDSA tool in the simulation although we are obviously not in a school context.

# Change Bundles and Degree of Belief

| Time: | Objectives | Materials: |
|---|---|---|
| 30 min | Participants will understand…<br>• how participant will, confidence in a change idea, and cost of failure factor in to decisions about the size of a test of change.<br>• The importance of using evidence to justify spreading a change to new contexts.<br>Participants will be able to…<br>• assess whether they have evidence to justify spreading a change to a new context. | Evidence Activity (5a)<br>Small Multiples Evidence Activity (6a) |

**Summary:**
**Mini-Lesson:** Building evidence through ramps of testing
Participant take-away: Evidence that a change is an improvement is generated through testing. Changes move up ramps of testing, as they are tested in more contexts and refined based on learning. Changes are not implemented as permanent changes to the system until we have built confidence that the change will result in quality with reliability at scale.

**Mini-Lesson:** Determining the scale of a test
Participant take-away: The scale of a test is determined by the confidence in the change idea, cost of failure, and participant will. By starting testing on a small scale and slowly expanding, it is possible to build will, build confidence, and mitigate cost of failure.

**Activity:** Assessing confidence in the change bundle
Participant take-away: Our confidence in a change should be based on evidence of its effectiveness. Evidence is context specific; evidence of effectiveness across multiple contexts can be compelling evidence to proceed to implementation.

**Narrative description:** You now shift again in the improvement journey, from Testing Changes and Building Evidence to Spread and Scale. This section begins with a mini-lesson on the role of evidence in a change process.

This simulation puts little focus on the role of measurement in improvement, although measurement and evidence are critical to getting rapid feedback to inform learning throughout the improvement journey. The discussion of evidence at this point in the simulation introduces the concept of a PDSA ramp, and the considerations that impact how widely a change is tested. A mini-lesson introduces those considerations, including a) the team's degree of confidence on the change ideas, b) the will of participants who must enact or experience the change, and c) the capacity of the system to do the change. Participants also see how multiple ideas might be tested simultaneously and eventually be grouped as a change package.

On the simulated improvement team, you fast-forward again to a point where the team has identified a package of high-leverage changes through a number of cycles of testing. Activities in the simulation center around the degree of belief participants have in that change package, and the evidence they have to support their belief. Participants are asked to indicate their degree of confidence in a change on a continuum from low confidence to high confidence, while you move across the room as a human indicator on the continuum. The simulation is set up for participants to consider first spreading the change bundle to one other school, based on their own school's evidence, and then to consider taking the change district-wide, based on evidence from three schools.

After seeing evidence of the impact of the change bundle on the rate of chronic absenteeism, the simulation ends. You can choose to share briefly about the actual case on which the simulation was based, including sharing the driver diagram that the site used to organize its theory of improvement.

## Reflection & Closing

| **Time:**<br>20 min | **Objectives**<br>Participants will understand…<br>• Improvement as a process of social learning that requires humility, empathy, and a commitment to rigorous inquiry.<br>• How improvement science differs from other approaches to change<br>Participants will be able to…<br>• Connect the experience of improvement science in the simulation to implications for their own practice | **Materials:**<br>Roses & Thorns (optional)<br>Feedback Form (optional) |
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**Summary:**
**Mini-lesson:** Key features of improvement science and getting started
Participant take-away: Improvement science in education is a process of social learning that is system-focused. It is non-linear, with decisions guided by the question, "What do we need to learn next?" It is a rigorous and disciplined practice.

**Activity:** Individual/Team reflection
Participant take-away: Personal reflections on how improvement science relates to their own experiences with change.

**Narrative description:** There are a number of different ways to close the simulation, depending on the audience and the group's potential for ongoing work together. At a minimum, it is helpful to recap the phases of improvement that participants experienced, as well as key takeaways about improvement science as an approach to change. The ideas of a system focus, disciplined inquiry, and the non-linearity of improvement are addressed directly through the simulation. The social

nature of the learning, however, is not as explicitly addressed but instead experienced through the activities, and is important to name in the closing.

The pace through the simulation has been quick, and audiences who come to the simulation with little prior exposure to improvement science benefit from a few moments of reflection to capture ideas and thinking. Adjust the prompts to suit the needs of your group, but do allow some individual or small group processing of the learning.