

Coaching Manual for the ENgagement and Achievement through Computational Thinking (ENACT) Intervention

Introduction

The ENACT intervention is a professional development and coaching process designed to empower and support mathematics teachers in integrating five core **computational thinking (CT) strategies** (pattern recognition, abstraction, decomposition, debugging, and algorithms) and **student-focused practices** into their classroom instruction. Derived from the field of computer science, CT strategies help students scaffold their understanding of complex problems and encourage them to think critically and strategically as they work on mathematics tasks. Student-focused practices are instructional practices that support students' interests, enhance their beliefs about their own academic abilities, and connect academic concepts to their daily lives. By integrating both CT strategies and student-focused practices into mathematics instruction, students' mathematics learning shifts from simply memorizing procedures to developing a deeper understanding of mathematics concepts, ultimately fostering more meaningful learning experiences.

As an intervention, ENACT is designed to be curriculum-agnostic, meaning that its methods can be adapted to suit any mathematics curriculum or learning goal that is specific to your district's context. This coaching manual provides the user with the necessary materials, tools, and resources to implement the ENACT intervention with middle school mathematics instructional staff.

Who should use this manual?

This manual is designed to help district or school staff who provide **support to mathematics instructional staff** serving middle school students (hereafter referred to as "coaches"). This may be instructional coaches, teacher leaders, or other technical assistance staff working with mathematics teachers. This manual is **not intended to provide step-by-step instructions** for teachers who are implementing CT strategies in their classrooms.

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Overview of the ENACT intervention

At its core, ENACT is a coaching and professional learning intervention that focuses on integrating five specific CT strategies and student-focused practices into mathematics instruction to equip students with problem-solving skills that go beyond rote memorization to foster deeper conceptual understanding. By integrating CT strategies into instruction, we help students see mathematics not just as a set of rules, but as a dynamic process of exploration and decisionmaking. In the classroom, CT strategies emphasize the use of reasoning, sensemaking, and connections that help students understand and apply mathematics in meaningful ways, leading to deeper mathematics learning.

The ENACT intervention is curriculum-agnostic and was designed with the typical middle school classroom in mind. It provides an “arc” of learning for middle school mathematics teachers to build foundational content knowledge in computational thinking and student-focused practices, and to apply those skills in their instructional practice. It does this by providing the following:

- An intentionally sequenced series of professional learning activities, including individual and group coaching, as well as live and recorded observations of instruction (used in coaching).
- Tools to engage in structured individual reflection on and assessment of the implementation of CT strategies and student-focused practices in the classroom.
- ENACT-related materials (for example, posters, instructional videos) that share additional classroom tools and instructional resources to support teachers’ implementation of CT-integrated lessons.

Overview of the ENACT coaching manual

This coaching manual is intended to be used in combination with materials and resources that are available on the Regional Educational Laboratory (REL) Midwest website. The manual provides an overview of the concepts of CT and student-focused practices, as well as detailed guidance and information for coaches on implementing each learning opportunity with middle school mathematics teachers, including the following:

- Facilitation guides, tips, and tricks for implementing the Launching Learning Institute and individual and group coaching sessions.
- Tools and materials to support the use of observations in assessing CT-integrated lesson implementation.
- Suggested timelines, coaching resources, and tips and tricks specifically for coaches.
- Templates for tracking teachers’ progress.
- Templates for teachers to use in planning CT-integrated lessons and tracking progress.
- Resources for teachers, including instructional videos, video guides, and classroom materials to print.

The manual’s appendices contain templates, printables, and detailed instructions on using and applying ENACT tools and resources. Appendix A provides coaching resources, appendix B provides teacher-facing resources, and appendix C provides instructional supports and

resources. Each set of resources serves a distinct purpose in ensuring successful coaching and learning outcomes. Below, we briefly describe the resources found in the appendices and on the REL Midwest website.

Coaching resources

ENACT coaching resources include planning tools, communication templates, and session-specific resources. These resources are intended to help coaches stay organized as they support teachers' instructional learning. The coaching resources described below can be found in appendix A and on the REL Midwest website.

Coaching year at a glance (appendix A1). This resource provides a suggested outline for the seven ENACT coaching sessions across the school year, including the timing, format (group or individual), participants, and key objectives for each session. It is intended to provide a quick point of reference for coaches to track milestones and plan for ongoing support around CT strategies and student-focused practices.

Individual coaching session fidelity checklists (appendix A2). Each individual coaching session should ideally provide a combination of supports, including co-planning, instructional support and observation, debriefing, and co-reflection after a lesson. The fidelity checklists are designed to be used in the planning and execution of coaching sessions to ensure that core elements of ENACT are carried out consistently with teachers across multiple touchpoints.

Individual and group coaching session agendas and slide decks (REL Midwest website). Each agenda includes coaching session objectives; pre-observation coaching action items (conceptual and logistical planning); and sections on lesson observation and support, debrief, and reflection. The agendas also suggest the amount of time to allocate for each session component, identify corresponding slides or materials, and include suggestions for coaches to guide facilitation. Each slide deck provides complete facilitation for the session, including session goals, the agenda, and detailed facilitation notes (embedded on each slide).

Teacher-facing resources

ENACT's teacher-facing resources are intended to guide and support teachers throughout the ENACT process, including the Launching Learning Institute and individual and group coaching sessions. The teacher-facing resources described below can be found in appendix B and on the REL Midwest website.

ENACT lesson log (appendix B1). This log allows teachers to capture activities, examples, and strategies for applying ENACT concepts in classroom settings.

ENACT teacher reflection form (appendix B2). This form contains reflective prompts to help teachers reflect on their CT-integrated lessons and student-focused practices. It can be shared with teachers for independent completion, or the coach can use the prompts during the debrief following a CT-integrated lesson observation.

ENACT lesson planning guide (appendix B3). This guide is designed to help teachers plan their first five ENACT lessons. The template supports teachers in identifying where each CT strategy fits within the overall curriculum, determining any necessary adjustments to the broader sequence of lessons, preparing required materials in advance, and introducing key phrases or vocabulary during the lessons.

Monthly teacher checklist (appendix B4). Teachers can use this checklist to ensure they are prepared for CT-integrated lesson implementation. Coaches can also use the checklist to ground coaching conversations with teachers.

Instructional supports and resources

Instructional supports and resources were developed as part of the ENACT intervention to provide additional information for teachers implementing CT strategies and student-focused practices in their classroom. They can also be scaffolded into coaching sessions. See the coaching year at a glance resource and session agendas for suggestions on when and how to scaffold in additional resources. The instructional supports and resources described below can be found in appendix C and on the REL Midwest website.

Instructions and links for using ENACT videos and video guides (appendix C1). REL Midwest created 20 videos and accompanying video guides to help teachers conceptualize how they might implement ENACT lessons in the classroom. Videos provide sample lessons that integrate CT strategies and student-focused practices into instruction by modeling CT, structuring opportunities for CT, and prompting and pointing out CT strategies. The accompanying video guides are intended to provide teachers with cues regarding important instructional practices, as well as further considerations for their own instruction.

In each of the 20 videos, explicit instances of CT, student-focused practices, pedagogical strategies, and mathematics instruction are highlighted on screen using the icons below. The accompanying video guides provide more detailed information about each example and a time stamp showing when each practice occurs in the video.



Computational Thinking



Student Focus



Pedagogy



Mathematics

ENACT observational tool and instructions on how to use it (appendix C2). We provide a blank template of the ENACT observational tool and instructions on how to use the tool for both live and recorded instructional observation. A recorded walkthrough of the observation tool can be found on the REL Midwest website. The tool is intended to be used by both coaches and teachers. It was designed specifically for the ENACT process and provides a framework for identifying the components of instructional practice that are important for implementing CT-integrated lessons and student-focused practices. The tool is NOT intended to be used to assess instructional practice. Rather, it is designed to facilitate conversations between a teacher and a

coach around strengths and areas for growth in instruction. See the coaching year at a glance resource (appendix A) for suggested observation timings and formats.

Templates for ENACT classroom posters and student bookmarks (appendix C3). These classroom visuals highlight key CT strategies. Posters should be displayed for easy reference to support students as they learn and apply CT strategies independently. Bookmarks give each student a handy, personal reference to all CT strategies, making it easy to reinforce learning during lessons and independent work.

Sample lesson plans for CT-oriented mathematics lessons (appendix C4). These hands-on sample exercises reinforce CT concepts in problem solving. They can be used by teachers as written or as the basis for lesson development.

Overview of CT strategies and student-focused practices

This section provides a brief explanation of five key CT strategies and key components of the framework for student-focused practices used in ENACT. This overview is not intended to be comprehensive; rather, it provides coaches with a foundational grounding in CT strategies and student-focused practices and can be used as a quick point of reference during coaching. More detailed information can be found in appendices A–C in this manual and in the online materials found on the REL Midwest website.

CT strategies

ENACT focuses on five CT strategies:

1. Pattern recognition.
2. Abstraction.
3. Decomposition.
4. Debugging.
5. Algorithms.

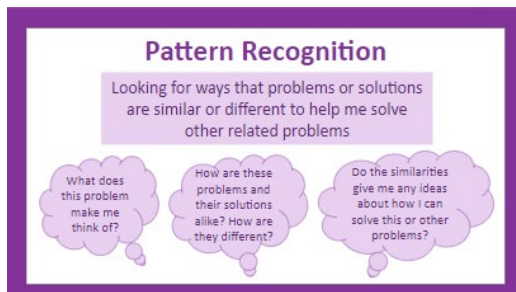
We refer to these practices using the acronym PRADDA, so that students can easily recall each practice while addressing mathematics problems. During the Launching Learning Institute, teachers will have an opportunity to engage with each of the five CT strategies, practice developing instructional strategies for CT, and work with coaches to develop a plan for incorporating each strategy into classroom instruction. (Note: The CT visuals aligned with each practice can be printed as posters to provide visual references in the classroom; see appendix C3).

The 20 ENACT videos provide examples of how a teacher might implement CT within a mathematics lesson. When CT strategies appear in a video, they are indicated on screen using the icon to the right. The corresponding video guide provides time stamps for instances of CT implementation in the video. Videos that align with each of the five CT strategies are indicated below.



Pattern recognition

Pattern recognition is the practice of identifying similarities and differences among problems or solutions to help solve new, related challenges. By recognizing patterns, learners can draw connections between current and past experiences, making it easier to approach unfamiliar problems.



When using pattern recognition, consider these guiding questions:

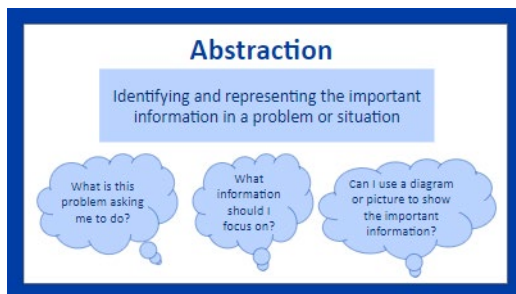
- What does this problem remind me of?
- Are there similarities that suggest possible solutions?
- In what ways are these problems and their solutions alike or different?

Applying pattern recognition helps you transfer knowledge from one situation to another, fostering creative problem solving and efficiency in learning new concepts.

(See videos 1, 9, 12, 15, and 20.)

Abstraction

Abstraction is the process of identifying and representing the most important information in a problem or situation, while filtering out unnecessary details. This helps students focus on what truly matters and makes complex problems easier to understand and solve.



When practicing abstraction, consider these guiding questions:

- What is this problem asking me to do?
- Can I use a diagram or picture to show the important information?
- What information should I focus on?

By using abstraction, students can simplify complex tasks, clarify their thinking, and communicate solutions more effectively. It encourages students to concentrate on the essential elements, making problem solving more manageable and efficient.

(See videos 2, 6, 11, 14, and 16.)

Decomposition

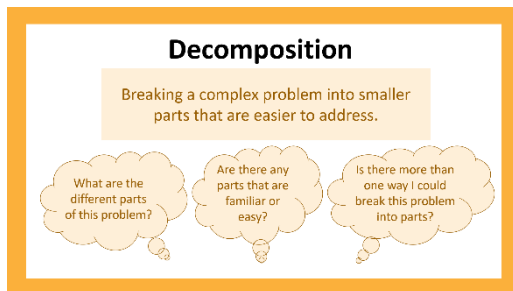
Decomposition is the process of breaking a complex problem into smaller, more manageable parts. Addressing each component individually makes it easier to understand and solve challenging tasks.

When practicing decomposition, consider these guiding questions:

- What are the different parts of this problem?
- Are there any parts that are familiar or easy?
- Is there more than one way I could break this problem into parts?

By using decomposition, students can tackle difficult problems step by step, identify areas that need special attention, and find multiple ways to approach a solution. This helps students organize their thinking and work efficiently toward solving complex issues.

(See videos 3, 7, 11, 13, and 19.)



Debugging

Debugging is the process of finding and fixing mistakes to improve your work. In computer science, debugging is a critical skill: Programmers regularly encounter errors in their code, and the ability to identify and correct what went wrong is essential for creating reliable software. Mistakes are a normal part of learning and problem solving. Debugging is not about avoiding errors; it is about reviewing your thinking or strategy, asking if your answer makes sense, and making changes to improve your results.

When practicing debugging, consider these guiding questions:

- Does my answer make sense for this problem?
- How can I review my thinking or my strategy?
- What changes can I make to improve my work?

Embracing debugging helps students learn from mistakes, refine their approach, and build resilience. In mathematics and beyond, debugging is a valuable practice for continuous improvement and success.

(See videos 5, 8, 13, 15, and 18.)



Algorithms

Algorithms are systematic, step-by-step approaches to problem solving. By following a clear sequence of actions, you can tackle tasks efficiently and consistently.

When using algorithms, consider these guiding questions:

- What steps did I use to solve this problem?
- Could I use the same steps on another problem?
- How could I communicate my steps to someone else?

Developing and applying algorithms helps students organize their approach, solve problems more effectively, and share their process with others. This method ensures that solutions are logical, repeatable, and easy to understand.

(See videos 4, 10, 12, 14, and 17.)

Student-focused practices

This section outlines the key student-focused practices that are used in the ENACT intervention. This overview is intended to launch coaches into a deeper understanding of student-focused practices as they support teachers in implementing each practice.

Student-focused practices are instructional moves that help create meaningful connections to students' experiences, support student choice by looking at multiple approaches to problem solving, and value student work and voice throughout the learning process. These practices also foster collaboration among students, encouraging them to work together and learn from one another. ENACT uses **four student-focused practices** (described below) to support student learning and sense of belonging. For each practice, we provide a brief definition and an example of what the practice might look like in instruction.

In each of the 20 ENACT videos, we highlight examples of how a teacher might integrate one or more student-focused practices into introducing, launching, and closing a CT lesson. Examples are highlighted in the videos using the icon to the right and are noted in the corresponding video guide.

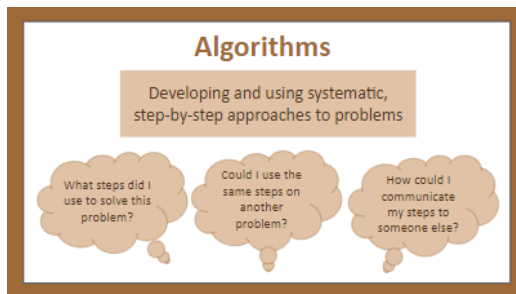


Connecting to student experiences

The teacher provides opportunities for students to make connections between the problems they are solving and a different context (or different content) with which they may be more familiar.

Classroom example.

The teacher says, “Some of you may have used unit rates when buying things at the grocery store.” “Can someone give me an example where they have used a unit rate in their everyday



life?” “Does anyone else have a different example of how a unit rate is used in your everyday life?”

Supporting student choice by enabling multiple approaches to problem solving

The teacher shares how problems within a lesson can be represented or solved in multiple ways, allowing students choice in how they approach complex problems.

Classroom example.

The teacher says, “This is what the pattern we just discussed would look like on a graph.” “I showed you one way of showing the pattern as a picture. Student 1 represented it in a different way, like this.” “Student 2 showed us how they solved the problem. Did someone else solve it in a different way that they want to share?”

Valuing student thinking and voice

The teacher provides opportunities for students to share their work and voice their thinking. This elevates students’ role in lessons and allows for ownership of their mathematical experiences.

Classroom example.

The teacher says, “Student 3 just gave us her reasoning for why she got her answer.” “Can someone tell me if they got the same answer or a different answer than Student 3, and explain their reasoning?” “Student 4 and Student 5 have both shared their answers and reasoning. Let’s discuss the ways in which their answers are the same or different.”

Supporting student collaboration

Teachers provide students with the opportunity to work together, build from one another’s knowledge and experiences, and share their work with the class. Peer collaboration provides new opportunities for students to both learn and lead in a small-group setting.

Classroom example.

The teacher says, “Let’s work on this together in groups.” “Let’s get back into groups. When we are done, one person from each group is going to share out the group’s answers.” “After we are done with group work, each group will present their approach, and the rest of the class will have a chance to ask them questions.”

ENACT foundations: Conceptual coaching framework and activity timeline and overview

In this section, we walk the user through the necessary steps to implement the Launching Learning Institute and the seven ENACT coaching sessions. Throughout, we include tips and tricks from our REL Midwest coaches to support implementation, as well as information on the alignment of resources, planning hints, and descriptions of important concepts aligned with each ENACT component.

The ENACT philosophy of coaching

To successfully coach teachers through the ENACT process, we strongly encourage coaches to understand the coaching philosophy that underpins the ENACT process and materials. A successful ENACT coach does not need to be an expert mathematician or an experienced mathematics coach. While these attributes are helpful, we firmly advocate that the approach to coaching ENACT should be one that is growth-oriented, non-evaluative, and centered on the teacher's own classroom experiences and contexts. Specifically, coaches should prioritize the following.

Delivering strengths-based and improvement-oriented coaching. ENACT coaching takes a strengths-based and improvement-oriented approach in all aspects of the intervention. Through the ENACT process, coaches will work with teachers to identify areas of strength and areas for improvement in instruction. This orientation will set coaches up for successful implementation of each aspect of ENACT.

Focusing on growth and feedback, not evaluation. ENACT is designed to develop teachers' skills in incorporating CT strategies, and to promote student-focused practices that improve learning outcomes. While components of ENACT include classroom observations, performance evaluation is not the primary goal. Coaches should focus on collaborating with teachers to identify strengths and areas for growth. Observations and rubrics serve as methods and tools to support teacher development, not to evaluate classroom practices.

Focusing on students. ENACT approaches coaching with a focus on supporting teachers to support their students. Coaches will focus not only on supporting teachers to use CT strategies, but also on integrating student-focused practices into their instruction. Several of the activities included in the Launching Learning Institute and group sessions focus on developing a teacher's awareness of their students' perspectives in the classroom. Students who can see themselves and their everyday lives in mathematics problems are more likely to be able to engage with and understand how to apply the ENACT strategies.

Developing trusting relationships with teachers. Spending time developing trusting relationships with teachers will enable coaches to deliver more productive and effective coaching sessions throughout the school year, and will help teachers feel more comfortable asking questions and seeking support from coaches. To develop strong and trusting relationships, coaches will embrace a growth mindset and approach the coaching process in a non-evaluative way.

Timeline and overview of ENACT activities

ENACT activities and coaching sessions are designed to support an “arc” of learning for teachers that sustains and deepens their understanding of each practice and supports continual growth in instructional practices. ENACT begins with the Launching Learning Institute (an intensive professional learning experience) and then progresses through seven structured coaching sessions that alternate between individualized support and collaborative group reflection and planning. Below we outline the basic orientation, timing, and format for each of the key components of ENACT. We then provide a more detailed calendar for the coaching year with suggested timings and formats.

Launching Learning Institute

- This is a three-day institute. In-person attendance is recommended.
- All teachers participate as a group.
- The institute focuses on developing a deeper understanding of CT strategies and student-focused practices.
- It includes a mix of interactive activities, group reflections, and content-focused learning.

Coaching sessions

- There are seven coaching sessions:
 - Four individual sessions (recommended duration of four hours each).
 - Three group sessions (recommended duration of two hours each).
- Sessions are spaced throughout the year to align with classroom implementation milestones.
- Individual sessions include co-planning, in-person support and observation, debriefing, and co-reflection after a lesson. Sessions can include live classroom observations or recorded lesson implementation using the ENACT observation tool.
- Group sessions provide opportunities for collective reflection and learning.

Suggested timeline for ENACT

ENACT supports teachers in applying CT strategies and student-focused practices by scaffolding learning

Key features of the Launching Learning Institute

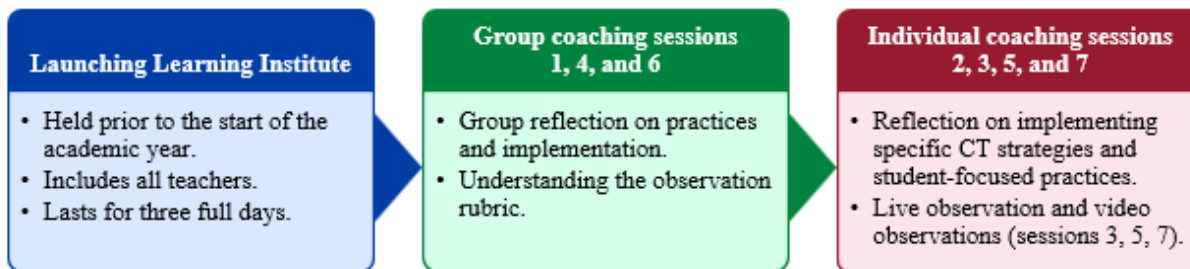
- Offers relationship-building opportunities.
- Alternates between building content knowledge and practicing concepts.
- Facilitates collaborative lesson planning.

Key features of coaching sessions

- **Individualized support.** The coach tailors feedback based on classroom observations and teacher reflections.
- **Collaborative learning.** Group sessions foster peer sharing and problem solving.
- **Video analysis.** Teachers record themselves teaching CT-integrated lessons for co-scoring and observation tool-based reflection.
- **Continuous planning.** Each session builds toward deeper integration of CT strategies and student-focused practices.

through alternating individual and group coaching sessions. The general outline of activities can be found in Exhibit 1.

Exhibit 1. ENACT Coaching Activities Outline



CT is computational thinking.

In the sections that follow, we provide information on timing, goals, and necessary resources and materials for the Launching Learning Institute and coaching sessions. Associated materials, slides, agendas, and other resources can be found in the appendices.

Launching Learning Institute

Learning goals

The ENACT Launching Learning Institute is a three-day professional learning experience that is designed to provide foundational knowledge and practice for teachers and coaches to implement CT strategies and student-focused practices through CT-integrated lessons. The institute combines hands-on activities, collaborative planning, and reflection to build a strong foundation for the ENACT coaching cycle.

Guides to implement the Launching Learning Institute

The Launching Learning Institute is structured so that CT strategies and student-focused practices are introduced slowly, allowing teachers time to collectively reflect, try out hands-on activities, and ask questions. The institute ends with structured time for teachers to plan their first implementation of CT-integrated instruction. The institute is best implemented prior to the start of the year to help teachers successfully launch instruction. Activities, materials, and slides are designed to be delivered in person but could potentially be adapted for virtual administration.

In Exhibit 2, we provide the key concepts presented each day during the Launching Learning Institute.

Exhibit 2. Launching Learning Institute agenda

Day	Topic areas	Key activities
Day 1	Decomposition, abstraction, debugging; ENACT foundations	<ul style="list-style-type: none"> • Overview of the five CT strategies and four student-focused practices. • Hands-on activities modeling decomposition, abstraction, and debugging, integrated with student-focused practices. • Coaching overview and end-of-day reflection and questions.
Day 2	Pattern recognition, algorithms; student-focused practices; exploring resources	<ul style="list-style-type: none"> • Hands-on activities for pattern recognition and algorithms. • Activity and reflection to integrate CT strategies with student-focused practices. • Review of coaching schedule and observation tool. • Exploration of ENACT videos and video guides.
Day 3	Preparing for classroom instruction	<ul style="list-style-type: none"> • Discussion and reflection on the following: <ul style="list-style-type: none"> – Framing lessons. – Prompting and reinforcing. – Incorporating routines. – Supporting student projects and presentations. • “Microteaching” practice and reflection. • Collective lesson planning.

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In Exhibit 3, we provide a list of recommended materials, printed handouts, and links to resources for use during each day’s activities. These suggestions are based on our experience implementing the Launching Learning Institute.

Exhibit 3. Launching Learning Institute materials and resources

Day	Materials	Linked resources and slides
Day 1	<p>General</p> <ul style="list-style-type: none"> • Sticky notes. • Chart paper. • Markers. • Name tags for each day of the institute. • Attendance sign-in. <p>For activities</p>	<p>General</p> <ul style="list-style-type: none"> • Launching Learning Institute agenda. • Day 1 slide deck. • Icebreaker prompts. <p>To print</p> <ul style="list-style-type: none"> • ENACT overview handout. • CT posters (one set per teacher). • CT bookmarks.

Day	Materials	Linked resources and slides
	<ul style="list-style-type: none"> • String. • Paper clips or clothes pins. • Pattern recognition manipulatives. • Fraction cards (print or make). 	<ul style="list-style-type: none"> • Student profiles handout. • CT definitions worksheet. • Slides 46 and 47 of the slide deck (debugging activity, “Insights into student thinking”).
Day 2	<p>General</p> <ul style="list-style-type: none"> • Sticky notes. • Chart paper. • Markers. • Name tags for each day of the institute. • Attendance sign-in. <p>For activities</p> <ul style="list-style-type: none"> • Manipulatives for practicing CT strategies. 	<p>General</p> <ul style="list-style-type: none"> • Launching Learning Institute agenda. • Day 2 slide deck. • Video guides for videos. • Video clips of classroom implementation. <p>To print</p> <ul style="list-style-type: none"> • Icebreaker bingo card. • Developing algorithm understanding handout. • Slide 32 of slide deck (ENACT coaching review). • Timeline of coaching handout. • Introduction to abstraction and pattern recognition handout. • Introduction to debugging, decomposition, and algorithms handout. • Lesson log and reflection form handout.
Day 3	<p>For activities</p> <ul style="list-style-type: none"> • Colored dot stickers for name tags, four colors (for micro-teaching assignments). 	<p>General</p> <ul style="list-style-type: none"> • Launching Learning Institute agenda. • Day 3 slide deck. <p>To print</p> <ul style="list-style-type: none"> • CT-integrated lesson log, reflection form. • District pacing guide.^a • Teacher unit guide.^a • Teacher upcoming lessons*.

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Coaching: Tips and tricks

The ENACT intervention focuses on the slow development of both content knowledge and trust between coaches and participants. The REL Midwest ENACT team has implemented more than six Launching Learning Institutes in an urban setting, with anywhere between 6 and 36 teachers. This section presents a compilation of the tips and tricks we have documented along the way to help districts successfully implement the ENACT intervention.

ENACT coaching sessions

Here, we provide goals, activities, materials and resources, and suggested time allocations for each of the coaching sessions, as well as coaching tips. This information is intended to provide a general guide for coaches to help with planning and executing each coaching session. We encourage coaches to modify the timing and scaffold in additional supports as needed, based on the teacher’s context and professional development needs.

ENACT coaching year at a glance

Exhibit 4 provides the suggested timing, format, length, and goals for each of the seven coaching sessions. The suggested timing and length for each session are recommendations only. Ideally, individual sessions would be conducted in person, but group sessions could be facilitated in person or virtually.

Exhibit 4. Coaching year-at-a-glance

Session	Suggested timeline	Session format	Suggested session length	Goals
Session 1	September	Small group	2 hours	<ul style="list-style-type: none">• Collaboratively reflect on implementation of the first lesson.• Identify ways to further integrate student-focused practices into lessons.
Session 2	October	Individual	4 hours	<ul style="list-style-type: none">• Observe, debrief, and co-reflect on classroom lesson implementation.• Plan for future lessons.
Session 3	November	Individual	4 hours	<ul style="list-style-type: none">• Observe, debrief, and co-reflect on classroom lesson implementation.• Plan for future lessons.
Session 4	January	Small group	2 hours	<ul style="list-style-type: none">• Collaboratively reflect on and plan opportunities to integrate CT strategies and student-focused practices into instruction.• Learn how to use the ENACT observation tool for feedback areas.

Session	Suggested timeline	Session format	Suggested session length	Goals
Session 5	February	Individual	4 hours	<ul style="list-style-type: none"> Teachers record one CT-integrated lesson prior to this session. Use the ENACT observation tool to score the instructional video and discuss instruction. Plan for future lessons.
Session 6	March	Small group	2 hours	<ul style="list-style-type: none"> Collaboratively reflect after implementing CT-integrated lessons and student-focused practices in instruction and using the ENACT observation tool to review teacher instructional practice.
Session 7	April/May	Individual	4 hours	<ul style="list-style-type: none"> Observe, debrief, and co-reflect on classroom lesson implementation (on site or video). Discuss areas of strength and improvement in instruction for the following year.

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ENACT coaching session outline

Exhibit 5 lists the general objectives and activities for each coaching session, as well as suggested learning supports.

Exhibit 5. Coaching sessions objectives and activities

Coaching activity	Session objectives	Activities
Coaching session 1: Small-group coaching	<ul style="list-style-type: none"> Teams establish a learning community across teachers and schools. Teachers learn novel strategies and approaches to instruction using the ENACT intervention. 	<ol style="list-style-type: none"> Teachers share reflections on CT-integrated lesson successes and challenges and collaboratively brainstorm solutions to challenges. Coach supports teachers to identify opportunities to use student-focused practices in lessons. Teachers practice planning lessons that incorporate CT strategies.

Coaching activity	Session objectives	Activities
Coaching session 2: Individual coaching	<ul style="list-style-type: none"> • Coach observes and supports teacher’s instructional practice and integration of CT strategies. • Teacher reflects on CT-integrated lesson implementation. • Coach supports teacher to plan for future lesson implementation. 	<ol style="list-style-type: none"> 1. Coach observes one CT-integrated lesson. 2. Coach and teacher debrief on lesson implementation. 3. Coach reviews implementation records. 4. Coach and teacher co-plan for upcoming CT-integrated lesson.
Coaching session 3: Individual coaching	<ul style="list-style-type: none"> • Coach observes and supports teacher’s instructional practice and integration of CT strategies. • Teacher reflects on CT-integrated lesson. • Coach supports teachers to plan for future lesson implementation. 	<ol style="list-style-type: none"> 1. Coach observes one CT-integrated lesson. 2. Coach and teacher debrief on lesson implementation. 3. Coach reviews implementation records. 4. Coach and teacher co-plan upcoming CT-integrated lesson.
Coaching session 4: Small-group coaching	<ul style="list-style-type: none"> • Coach supports and fosters learning community across teachers and schools. • Teachers deepen understanding of novel strategies and approaches to instruction using ENACT intervention. • Teachers learn how to use the ENACT observation tool as an instructional practice support. 	<ol style="list-style-type: none"> 1. Teachers share reflections on CT-integrated lesson successes and challenges and collaboratively brainstorm solutions to challenges. 2. Coach supports teachers to identify opportunities to use student-focused practices in lessons. 3. Teachers practice using the ENACT observational tool to reflect on CT-integrated lesson videos and begin choosing focused areas for feedback.
Coaching session 5: Individual coaching	<ul style="list-style-type: none"> • Coach observes and supports teacher’s instructional practice and integration of CT strategies. • Teacher reflects on CT-integrated lesson. • Coach supports teachers to plan for future lesson implementation. 	<ol style="list-style-type: none"> 1. Teacher records one CT-integrated lesson. 2. Coach and teacher co-score CT-integrated lesson recordings. 3. Coach and teacher debrief CT-integrated lesson implementation. 4. Coach reviews implementation records. 5. Coach and teacher co-plan for future CT-integrated lesson implementations.

Coaching activity	Session objectives	Activities
Coaching session 6: Small-group coaching	<ul style="list-style-type: none"> Coach supports and fosters a learning community across teachers and schools. Teachers deepen understanding of novel strategies and approaches to instruction using the ENACT intervention. Teachers and coaches plan next steps for implementing CT-integrated lessons into instructional practice. 	<ol style="list-style-type: none"> Teachers share reflections on CT-integrated lesson successes and challenges and collaboratively brainstorm solutions to challenges. Coach supports teachers to determine focus areas and design plans for the remainder of the school year.
Coaching session 7: Individual coaching	<ul style="list-style-type: none"> Teachers strengthen practice of integrating CT strategies and student-focused practices into lessons. Teachers and coaches plan next steps for implementing CT-integrated lessons and student-focused practices in next school year's strategy. 	<ol style="list-style-type: none"> Coach observes one CT-integrated lesson. Coach and teacher debrief on lesson implementation. Coach reviews implementation records. Coach and teacher identify and discuss implications for future CT-integrated lessons. Coach supports teacher to plan for the next school year's implementation.

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Exhibit 6 summarizes the objectives for each coaching activity and lists the relevant coaching materials and teacher-facing materials.

Exhibit 6. Coaching activity materials and resources (linked)

Coaching activity	Objective	Coaching materials	Teacher-facing materials
Coaching session 1: Group coaching	<ul style="list-style-type: none"> Teams establish a learning community across teachers and schools. Teachers learn novel strategies and approaches to instruction using the ENACT intervention. 	Session 1 agenda. Coaching session 1 slide deck.	Lesson log. Reflection form.

Coaching activity	Objective	Coaching materials	Teacher-facing materials
Coaching session 2: Individual coaching	<ul style="list-style-type: none"> Coach observes and supports teachers' instructional practice and integration of CT strategies. Teachers reflect on CT-integrated lesson implementation. Coach supports teachers to plan for future lesson implementation. 	Session 2 agenda. Individual coaching fidelity checklist.	Lesson log. Reflection form. Lesson planning guide.
Coaching session 3: Individual coaching	<ul style="list-style-type: none"> Similar to coaching session 2: Coach conducts observations, debrief, and co-plan with teachers for deeper CT integration. 	Session 3 agenda. Individual coaching fidelity checklist.	Lesson log. Reflection form.
Coaching session 4: Group coaching	<ul style="list-style-type: none"> Group reflection and planning; teachers learn to use the ENACT observation tool for feedback. 	Session 4 agenda. Coaching session 4 slide deck. ENACT observation tool.	Lesson log. Reflection form.
Coaching session 5: Individual coaching	<ul style="list-style-type: none"> Teacher records a CT-integrated lesson; coach and teacher co-score and debrief using the observation tool. 	Session 5 agenda. Individual coaching fidelity checklist. ENACT observation tool.	Lesson log. Reflection form.
Coaching session 6: Group coaching	<ul style="list-style-type: none"> Group reflection after implementing CT-integrated lessons and using the observation tool. 	Session 6 agenda. Coaching session 6 slide deck. ENACT observation tool.	Lesson log. Reflection form.
Coaching session 7: Individual coaching	<ul style="list-style-type: none"> Coach observes a CT-integrated lesson, debriefs, and co-plans future lessons with the teacher. 	Session 7 agenda. Individual coaching fidelity checklist.	Lesson log. Reflection form. Lesson planning guide.

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ENACT coaching manual: Closing and summary

ENACT is a promising intervention for supporting students' abilities and self-confidence as mathematics learners. We strongly believe that the success of the intervention relies not just on the products and materials we have developed, but also on the development of strong, collaborative coaching relationships between teachers and coaches. We encourage coaches to use the resources and strategies included in this manual and on the REL Midwest website to support implementation. We also encourage them to consider how additional scaffolding and adjustments to timing and example lessons could be used to meet the specific needs of their district, schools, and teachers.

Appendix A. Coaching Resources

In this appendix, we provide the following resources:

- Appendix A1: Coaching Year at a Glance
- Appendix A2: Individual Coaching Session Fidelity Checklists

Appendix A1. Coaching Year at a Glance

Session	Suggested timeline	Session format	Session participants	Session length	Objectives
Session 1	September	Small group	All teachers and coach	2 hours	<ul style="list-style-type: none"> Share reflections on CT-integrated lessons and collaboratively brainstorm solutions to challenges. Identify opportunities to use student-focused practices in lessons. Practice planning lessons to incorporate CT strategies.
Session 2	October	Individual	One on one, teacher and coach	4 hours	<ul style="list-style-type: none"> Observe one CT-integrated lesson [coach]. Debrief on lesson implementation. Review implementation records. Plan for future CT-integrated lesson implementations.
Session 3	November	Individual	One on one, teacher and coach	4 hours	<ul style="list-style-type: none"> Observe one CT-integrated lesson [coach]. Debrief on lesson implementation. Review implementation records. Plan for future CT-integrated lesson implementations.
Session 4	January	Small group	All teachers and coach	2 hours	<ul style="list-style-type: none"> Share reflections on CT-integrated lessons and collaboratively brainstorm solutions to challenges. Identify opportunities to connect CT-integrated lessons to students' lives. Practice using the ENACT rubric to reflect on CT-integrated lesson videos and begin choosing areas for feedback.
Session 5	February	Individual	One on one, teacher and coach	4 hours	<ul style="list-style-type: none"> Record one CT-integrated lesson [teacher]. Co-score the recorded CT-integrated lesson.

Session	Suggested timeline	Session format	Session participants	Session length	Objectives
					<ul style="list-style-type: none"> • Debrief on CT-integrated lesson implementation. • Review implementation records. • Plan for future CT-integrated lesson implementation.
Session 6	March	Small group	All teachers and coach	2 hours	<ul style="list-style-type: none"> • Identify and share successful CT-integrated lessons and student-focused practices. • Make plans for what to focus on for the rest of the school year.
Session 7	April/May	Individual	One on one, teacher and coach	4 hours	<ul style="list-style-type: none"> • Observe one CT-integrated lesson [coach]. • Debrief on CT-integrated lesson implementation. • Review implementation records. • Plan for remaining CT-integrated lesson implementation.

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Appendix A2. Individual Coaching Session Fidelity Checklists



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ENACT Individual Coaching Fidelity Checklists

Coaching session 2

Purpose of this checklist

This checklist is designed to support coaches in providing high-quality and consistent coaching to participating teachers. Use of this checklist will help ensure that core elements of the coaching sessions are carried out consistently across multiple touchpoints with teachers.

How to use this checklist

This checklist is designed to be used by the coach before, during, and after a coaching session. A summary of each required component is included in the coaching procedure column. The date column should be used to mark the date each required component is completed. The notes column is for any notes related to each fidelity component. At the end of the form, there is space for the coach to reflect independently on the coaching session. Reflection notes should be completed after each session. The questions are designed to prompt reflection on the quality of the coaching session.

Date ✓	Coaching procedure	Notes
1. One week before the visit		
	a. Support conceptual lesson planning. Contact the classroom teacher prior to the in-person coaching session to clarify any questions they may have about the upcoming CT-integrated lesson.	
	b. Facilitate logistical lesson planning. Decide who will lead which parts of the CT-integrated lesson, and coordinate material development. Remind the teacher to complete their reflection form and update their lesson log before the visit.	
	c. Facilitate planning of the coaching day schedule. Coordinate with teachers to create an agenda that includes the location and time of coaching components (teaching, debrief) and how to gain access to the school building.	
2. During the visit		
	a. Observe and support one CT-integrated lesson with the classroom teacher.	

Date ✓	Coaching procedure	Notes
3. Within one week following the visit		
	a. Debrief on the CT-integrated lesson. Facilitate a conversation about first impressions on how the lesson went. Identify what went well and where the teacher needs additional support. Set intentions for adjustments to practice.	
	b. Review teacher’s reflection form. Identify parts of the CT-integrated lesson that the teacher felt most comfortable leading. Identify areas of focus and practice based on teacher reflection. <i>If the teacher did not complete the teacher reflection form, ask the questions from the form in a discussion to facilitate reflection.</i>	
	c. Review the lesson log and plan future CT-integrated lesson implementation with the teacher. Prompt the teacher to consider future lesson planning using the ENACT lesson log. Facilitate reflection on the following questions about potential milestones: <ul style="list-style-type: none"> • Have you introduced all five CT strategies to students? • Which CT strategies are students ready to take greater ownership of? • Which student-focused practices have you tried? What might you try next? 	
	d. Provide a summary of key takeaways from the teacher debrief. Email the teacher a brief recap of key takeaways and next steps that were identified during the coaching session.	

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Coach reflection

Please provide a brief summary of your coaching session and key takeaways.

Planning for future sessions

Reflect on the **barriers** that prevented the completion of these fidelity steps in your coaching session, **potential solutions** to these barriers, and any **supports you need** to complete the fidelity checklist during the next coaching session. Create a plan to address these components during the next coaching session based on this reflection.

Fidelity component	Barriers	Solutions	Supports needed
Plan for next session:			

ENACT Individual Coaching Fidelity Checklist

Coaching session 3

Purpose of this checklist

This checklist is designed to support coaches in providing high-quality and consistent coaching to participating teachers. Use of this checklist will help ensure that core elements of the coaching sessions are carried out consistently across multiple touchpoints with teachers.

How to use this checklist

This checklist is designed to be used by the coach before, during, and after a coaching session. A summary of each required component is included in the coaching procedure column. The date column should be used to mark the date each required component is completed. The notes column is for any notes related to each fidelity component. At the end of the form, there is space for the coach to reflect independently on the session. Reflection notes should be completed after each session.

Date ✓	Coaching procedure	Notes
1. One week before the visit		
	a. Support conceptual lesson planning. Contact the classroom teacher prior to the in-person coaching session to clarify any questions they may have about the upcoming CT-integrated lesson.	
	b. Facilitate logistical lesson planning. Decide who will lead which parts of the CT-integrated lesson, and coordinate material development. Remind the teacher to complete their reflection form and update their lesson log before the visit.	
	c. Facilitate planning of the coaching day schedule. Coordinate with teachers to create an agenda that includes the location and time of coaching components (teaching, debrief).	
2. During the visit		
	a. Observe and support one CT-integrated lesson with the classroom teacher.	
3. Within one week following the visit		

Date ✓	Coaching procedure	Notes
	<p>a. Debrief CT-integrated lesson. Facilitate a conversation about first impressions on how the lesson went. Identify what went well and where the teacher needs additional support. Set intentions for adjustments to practice.</p>	
	<p>b. Review teacher reflection form. Identify parts of the CT-integrated lessons that the teacher felt most comfortable leading. Review the student-focused practices the teacher used and wants to try in the future. Identify areas of focus and practice based on teacher reflection.</p> <p><i>If the teacher has not completed a reflection form, go over the questions on the form in a discussion.</i></p>	
	<p>c. Review the lesson log and plan future lesson implementation with the teacher. Prompt the teacher to consider future lesson planning using the ENACT lesson log. Facilitate reflection on the following questions about potential milestones:</p> <ul style="list-style-type: none"> • Have you introduced all five CT strategies to students? • Which CT strategies are students ready to take greater ownership of? • Which student-focused practices have you tried? What might you try next? 	
	<p>d. Provide a summary of key takeaways from the teacher debrief. Email the teacher a brief recap of key takeaways and next steps that were identified during the coaching session.</p>	

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Coach reflection

Please provide a brief summary of your coaching session and key takeaways.

Planning for future sessions

Reflect on the **barriers** that prevented the completion of these fidelity steps in your coaching session, **potential solutions** to these barriers, and any **supports you need** to complete the fidelity checklist during the next coaching session. Create a plan to address these components during the next coaching session based on this reflection.

Fidelity component	Barriers	Solutions	Supports needed
Plan for next session:			

ENACT Individual Coaching Fidelity Checklist

Coaching session 5

Purpose of this checklist

This checklist is designed to support coaches in providing high-quality and consistent coaching to participating teachers. Use of this checklist will help ensure that core elements of the coaching sessions are carried out consistently across multiple touchpoints with teachers.

How to use this checklist

This checklist is designed to be used by the coach before, during, and after a coaching session. A summary of each required component is included in the coaching procedure column. The date column should be used to mark the date each required component is completed. The notes column is for any notes related to each fidelity component. At the end of the form, there is space for the coach to reflect independently on the session. Reflection notes should be completed after each session.

Date ✓	Coaching procedure	Notes
1. Beginning three weeks before the visit		
	a. Support the teacher to choose dimensions. Send the ENACT observation tool to the teacher. Prompt the teacher to choose two dimensions to focus on from the ENACT observation tool.	
	b. Review and rate the teacher’s recorded CT-integrated lesson on the chosen dimensions. Request that the teacher share a recorded CT-integrated lesson. Watch the recorded CT-integrated lesson and rate it on all dimensions. Prepare to discuss only the teacher’s chosen dimensions. Prompt the teacher to review the video using the ENACT observation tool.	
	c. Debrief on the CT-integrated lesson video. Meet with the teacher to discuss ratings of the video for the chosen dimensions. Set intentions for what the teacher will try and what the coach will watch for during the live observation.	
	d. Facilitate logistical planning. Coordinate with the teacher to create an agenda that includes the location and time of coaching components (teaching, debrief). Decide who will lead which parts of the CT-integrated lesson, and coordinate material development. Remind the teacher to update their lesson log before the visit. (Note that the video discussion takes the place of the teacher reflection forms in sessions 5 and 7.)	

Date ✓	Coaching procedure	Notes
2. During the visit		
	a. Observe and support one CT-integrated lesson in person, paying attention to the intentions set in the lesson video debrief.	
3. Within one week following the school visit		
	a. Debrief on CT-integrated lesson. Facilitate a conversation about first impressions on how the lesson went. Identify what went well and where the teacher needs additional support. Set intentions for adjustments to practice based on the teacher's chosen dimensions.	
	b. Review the lesson log and plan future lesson implementation with the teacher. Prompt the teacher to consider future lesson planning using the ENACT lesson log. Facilitate reflection on the following questions about potential milestones: <ul style="list-style-type: none"> • Have you introduced all five CT strategies to students? • Which CT strategies are students ready to take greater ownership of? • Which student-focused practices have you tried? What might you try next? 	
	c. Provide a summary of key takeaways from the teacher debrief. Email the teacher a brief recap of key takeaways and next steps that were identified during the coaching session.	
	d. Support teachers to choose dimensions. After coaching session 5, prompt the teacher to choose two dimensions to focus on from the ENACT observation tool.	

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Coach reflection

Provide a brief summary of your coaching session and key takeaways.

Planning for future sessions

Reflect on the **barriers** that prevented the completion of these fidelity steps in your coaching session, **potential solutions** to these barriers, and any **supports you need** to complete the fidelity checklist during the next coaching session. Create a plan to address these components during the next coaching session based on this reflection.

Fidelity component	Barriers	Solutions	Supports needed
Plan for next session:			

ENACT individual coaching fidelity checklist

Coaching session 7

Purpose of this checklist

This checklist is designed to support coaches in providing high-quality and consistent coaching to participating teachers. Use of this checklist will help ensure that core elements of the coaching sessions are carried out consistently across multiple touchpoints with teachers.

How to use this checklist

This checklist is designed to be used by the coach before, during, and after a coaching session. A summary of each required component is included in the coaching procedure column. The date column should be used to mark the date each required component is completed. The notes column is for any notes related to each fidelity component. At the end of the form, there is space for the coach to reflect independently on each session. Reflection notes should be completed after each session.

Date ✓	Coaching procedure	Notes
1. Beginning three weeks before the visit		
	a. Support the teacher to choose dimensions. Send the ENACT observation tool to the teacher. Prompt the teacher to choose two dimensions to focus on from the ENACT observation tool.	
	b. Review and rate the teacher’s recorded CT-integrated lesson on chosen dimensions. Ask the teacher to share a recorded CT-integrated lesson. Watch the recorded CT-integrated lesson and rate it on all dimensions. Prepare to discuss only the teacher’s chosen dimensions. Prompt the teacher to review and self-assess the video using the ENACT observation tool.	
	c. Debrief the CT-integrated lesson video. Meet with the teacher to discuss ratings of the video for the chosen dimensions. Set intentions for what the teacher will try and what the coach will watch for during the live observation.	
	d. Facilitate logistical planning. Coordinate with the teacher to create an agenda that includes the location and time of coaching components (teaching, debrief). Decide who will lead which parts of the CT-integrated lesson, and coordinate material development. Remind the teacher to update their lesson log before the visit. (Note that the video discussion takes the place of the teacher reflection forms in sessions 5 and 7.)	

Date ✓	Coaching procedure	Notes
2. During the visit		
	a. Observe and support one CT-integrated lesson in person, paying attention to the intentions set in the lesson video debrief.	
3. Within one week following the visit		
	a. Debrief the CT-integrated lesson. Facilitate a conversation about first impressions on how the lesson went. Identify what went well and where the teacher needs additional support. Set intentions for adjustments to practice based on the teacher’s chosen dimensions.	
	b. Review the lesson log and progress. Prompt the teacher to consider future lesson planning using the ENACT lesson log. Facilitate reflection on the following questions about potential milestones: <ul style="list-style-type: none"> • Have you introduced all five CT strategies to students? • Which CT strategies are students ready to take greater ownership of? • Which student-focused practices have you tried? What might you try next? 	
	c. Plan next steps with the teacher. Prompt the teacher to reflect on what they are taking away from their participation this year. Facilitate a conversation about things they want to continue working on next year.	
	d. Provide a summary of key takeaways from the teacher debrief. Email the teacher a brief recap of key takeaways and next steps that were identified during the coaching session. Thank the teacher for their participation.	

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Coach reflection

Please provide a brief summary of your coaching session and key takeaways.

Planning for future sessions

Reflect on the **barriers** that prevented completing these fidelity steps in your coaching session, **potential solutions** to these barriers, and any **supports you need** to complete the fidelity checklist during the next coaching session. Create a plan to address these components during the next coaching session based on this reflection.

Fidelity component	Barriers	Solutions	Supports needed
Plan for next session:			

Appendix B. Teacher-Facing Resources

In this appendix, we provide the following:

- Appendix B1: ENACT Lesson Log
- Appendix B2: ENACT Teacher Reflection Form
- Appendix B3: ENACT Lesson Planning Guide
- Appendix B4: Monthly Teacher Checklist

ENgagement and Achievement through Computational Thinking (ENACT) Teacher Reflection Form

**Note that this reflection form can be used individually by a teacher or as a questioning tool by the coach.*

Please answer the following questions as you reflect on the computational thinking (CT)-integrated lessons you implemented in your classroom since the last coaching session.

1. On a scale from 1 to 5, how do you feel the CT-integrated lessons have been going? (1 being Not well and 5 being Very well.)

Not well 1 2 3 4 5 Very well

2. What worked well as you integrated computational thinking strategies in your math lessons? What could you improve?

Worked well:

Areas for improvement:

3. On a scale from 1 to 5, how engaged did you feel students were when you implemented CT-integrated lessons? (1 being Not at all engaged and 5 being Completely engaged.)

Not at all engaged 1 2 3 4 5 Completely engaged

4. What are your reflections about why students may or may not have been engaged?

5. What specific strategies do you use to connect the CT-integrated lessons to students' lives and ensure participation from all students? What additional strategies might you use to engage students in the future?

ENACT Lessons 1–5: Planning Guide

This planning guide will assist you in planning your first five ENACT lessons. In these lessons, you will formally introduce each of the five computational thinking (CT) practices within a math lesson. The planner will support you in answering the guiding questions in the box below.

Guiding questions

- Where will each CT practice fit into the scope and sequence of the early parts of your math curriculum?
- Will any of the CT lessons require adjustment of the curriculum schedule?
- What materials may be helpful for you to revisit prior to introducing the CT practice?
- What key phrases may be helpful to use when introducing, prompting, or eliciting student connections to the CT practices?

Use the table on the next page to take notes on each lesson plan. Consider how the activity will fit into the scope and sequence of the math curriculum.

Use the space provided to record any general planning notes.

General notes

ENACT lesson planner (Introducing a CT practice)

Which CT practice am I introducing? _____

What math lesson do I want to introduce this CT practice in? _____

Content	Where within the lesson will I introduce the CT practice?	How will I introduce the practice? (What are the key aspects to model or think aloud?)	How will I adjust my lesson goal to include attention to CT?
Student engagement	What strategies will you use to engage your students in the CT practice?	How can you connect the lesson to students' lived experiences? What examples or contexts might be useful?	What accommodations and modifications should be built into materials and instruction to support all learners?
Questions and solutions	Questions to resolve	Potential collaborators and solutions	What teacher and student materials need to be prepared ahead of time?
Scheduling	Where does this lesson come up in the curriculum sequence?	What adjustments need to be made to the pacing calendar?	What materials will be helpful to revisit prior to teaching the lesson?

Appendix B4. Monthly Teacher Checklist



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ENACT Teacher Checklist

Prior to coaching sessions	To do
Three days (dates set by coach)	Attend day 1, day 2, and day 3. Launching Learning Institute day 3: Ensure the coach has your schedule as well as your before- or after-school obligations.
Session 1	Before session
Overview of the to-dos	Update your lesson log each week. Group session (session 1) scheduled date and time: _____ Record yourself teaching a CT-integrated lesson. Share with coach (recording 1). Completed date: _____
Session 2	Before, during, and after session
Overview of the to-dos	Update your lesson log each week. Schedule a prework/planning meeting with your coach for the CT-integrated lesson. Scheduled date and time: _____ Arrange with your coach to be present in your classroom for a CT-integrated lesson (session 2). Scheduled date and time: _____ <ul style="list-style-type: none"> • Schedule a debrief meeting with your coach after the classroom visit. • Scheduled date and time: _____
Session 3	Before, during, and after session
Overview of the to-dos	Update your lesson log each week. Schedule a prework/planning meeting with your coach for the CT-integrated lesson. Scheduled date and time: _____ Arrange with your coach to be present in your classroom for a CT-integrated lesson (session 2). Scheduled date and time: _____ <ul style="list-style-type: none"> • Schedule a debrief meeting with your coach after the classroom visit. • Scheduled date and time: _____
Checkpoint	Between session 3 and session 4
Overview of the to-dos	Have you introduced all five CT strategies at this point? <ul style="list-style-type: none"> • Work towards ENACT goals you have set for yourself and with your coach.

Session 4		• Before and after session	
Overview of the to-dos	Update your lesson log each week.	Group session (session 4) scheduled date and time: _____	Record yourself teaching a CT-integrated lesson. Share with coach (recording 2).
	Completed date: _____		Completed date: _____
			<ul style="list-style-type: none"> • Work towards ENACT goals you have set for yourself and with your coach.
Session 5		Before, during, and after session	
Overview of the to-dos	Update your lesson log each week.	Schedule a prework/planning meeting with your coach for the CT-integrated lesson.	Scheduled date and time: _____
	Arrange with your coach to be present in your classroom for a CT-integrated lesson (session 5). Scheduled date and time: _____		
			<ul style="list-style-type: none"> • Schedule a debrief meeting with your coach after the classroom visit.
			Scheduled date and time: _____
Session 6		Before and after session	
Overview of the to-dos	Update your lesson log each week.	Group session (session 6) scheduled date and time: _____	Record yourself teaching a CT-integrated lesson. Share with coach (recording 3).
	Completed date: _____		Completed date: _____
Session 7		Before, during, and after session	
Overview of the to-dos	Update your lesson log each week.	Schedule a prework/planning meeting with your coach for the CT-integrated lesson.	Scheduled date and time: _____
	Arrange with your coach to be present in your classroom for a CT-integrated lesson (session 7). Scheduled date and time: _____		
			<ul style="list-style-type: none"> • Schedule a debrief meeting with your coach after the classroom visit.
			Scheduled date and time: _____
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Appendix C. Instructional Supports and Resources

In this appendix, we provide the following:

- Appendix C1: Instructions and Links for Using ENACT Videos and Video Guides
- Appendix C2: ENACT Observational Tool and Instructions on How to Use It
- Appendix C3: Templates for ENACT Classroom Posters and Student Bookmarks
- Appendix C4: Sample Lesson Plans for CT-Oriented Mathematics Lessons

Appendix C1. Instructions and Links for Using ENACT Videos and Video Guides

The ENACT coaching intervention includes short videos that model how computational thinking (CT) strategies and student-focused practices can be integrated into a middle school mathematics lesson. Each video features a teacher who has integrated CT strategies into a lesson. Videos 16–20 also feature real students receiving classroom instruction.

In each video, the presenting teacher does the following:

- Describes connections between CT strategies, student-focused practices, and mathematics lesson content and pedagogy.
- Models practical implementation strategies.
- Models the teaching of key points within the lesson.


Structure of the video series

The videos are intentionally grouped to support scaffolded learning for teachers.

- Videos 1–5: An introduction to each of the CT strategies (pattern recognition, abstraction, decomposition, debugging, and algorithms).
- Videos 6–10: Modeling of one or two CT strategies in instruction with different mathematics problems.
- Videos 11–15: Instructional strategies for pointing out CT strategies and prompting student thinking.
- Videos 16–20: Real students in a classroom with a teacher delivering CT-focused mathematics lessons.

Exhibit C1.1 Video Icons

ENACT video icons



Computational thinking

- Scope and sequence of CT practices.
- How CT practices are tied to mathematics.
- Links between CT practices.

Mathematics

- How concepts in the videos tie to other mathematical concepts.
- Additional background on the mathematical concepts.

Student focus

- Examples of how the coach applies our four student-focused practices in the videos.

Pedagogy

- Examples of teaching practices to support implementation of CT and student-focused instruction.

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Video guides

Each video is accompanied by a corresponding video guide. The video guides are intended to provide additional support for teachers as they navigate the video series and each video's content. The icons in each video (Exhibit C1.1) identify specific moments in the video where key CT strategies, mathematics instruction, student-focused practices, and pedagogical strategies are clearly modeled in instruction. The video guides provide additional information about the practice that was modeled. They also provide time stamps so that teachers can refer back to the portion of the video they are most interested in seeing.

Recommended use in coaching. We recommend providing an opportunity to explore the videos and video guides during the Launching Learning Institute and referring to them often as you provide coaching. Exhibit C1.2 provides an outline of how each video connects to a CT strategy, the focus of the video, and links to each video on the Regional Educational Laboratory (REL) Midwest website.

Exhibit C1.2. Video series details and links

Video number	CT strategy	Video focus	Video link	Video guide link
1	Pattern recognition	Introduction video	YouTube: ENACT Lesson 1	
2	Abstraction	Introduction video	YouTube: ENACT Lesson 2	
3	Decomposition	Introduction video	YouTube: ENACT Lesson 3	
4	Algorithms	Introduction video	YouTube: ENACT Lesson 4	
5	Debugging	Introduction video	YouTube: ENACT Lesson 5	
6	Abstraction	Using tables as a tool for abstraction	YouTube: ENACT Lesson 6	
7	Decomposition	Using decomposition in complex problems	YouTube: ENACT Lesson 7	
8	Debugging	Recording strategies and intermediate steps in complex problems	YouTube: ENACT Lesson 8	
9	Pattern recognition	Applying patterns to different types of mathematics problems	YouTube: ENACT Lesson 9	
10	Algorithm	Developing algorithms	YouTube: ENACT Lesson 10	
11	Abstraction and decomposition	<i>Pointing and prompting:</i> Fractions and word problems	YouTube: ENACT Lesson 11	
12	Algorithms and pattern recognition	<i>Pointing and prompting:</i> Approaching mathematics problems	YouTube: ENACT Lesson 12	
13	Decomposition and debugging	<i>Pointing and prompting:</i> Using manipulatives	YouTube: ENACT Lesson 13	
14	Algorithms and abstraction	<i>Pointing and prompting:</i> Surface area mathematics problems	YouTube: ENACT Lesson 14	
15	Debugging and pattern recognition	<i>Pointing and prompting:</i> Judging the reasonableness of answers	YouTube: ENACT Lesson 15	

Video number	CT strategy	Video focus	Video link	Video guide link
16	Abstraction	<i>Live instruction:</i> Surface areas, nets, and applying real-world problems	YouTube: Abstraction Live Instruction	
17	Algorithms	<i>Live instruction:</i> Solving equations with missing values	YouTube: Algorithms Live Instruction	
18	Debugging	<i>Live instruction:</i> Solving equations using graphs	YouTube: Debugging Live Instruction	
19	Decomposition	<i>Live instruction:</i> Ordering rational numbers	YouTube: Decomposition Live Instruction	
20	Pattern recognition	<i>Live instruction:</i> Ratios and conversions using mathematical representations	YouTube: Pattern Recognition Live Instruction	

Appendix C2. ENACT Observational Tool and Instructions on How to Use It

Regional Educational Laboratory Midwest

ENACT Observation Protocol—Rating Sheet

Reminder: Be sure to fully review rating guidance documentation before conducting an observation.

Section 1. General information

District:	School:		
Teacher name:	Lesson objective:		
Grade:	Date:	Time in:	Time out:
Number of students:	Observer:		
Additional notes on classroom environment:			

Dimension	A1. Connects to student experiences and identities		
Definition	The teacher provides opportunities for students to make connections between the problems they are solving and a different context (or different content) with which they may be more familiar.		
Quality rating	<input type="checkbox"/> Low (1 point)	<input type="checkbox"/> Medium (2 points)	<input type="checkbox"/> High (3 points)
<input type="checkbox"/> Not applicable (0 points)	<ul style="list-style-type: none"> Makes an explicit connection between the lesson and something students' may have experienced in their lives outside of class. <i>"Some of you may have used unit rates when buying things at the grocery store."</i> 	<ul style="list-style-type: none"> Prompts one student to share an experience that they see as connected to the lesson. AND Makes an explicit connection between the lesson and an experience shared by one student. <i>"Can someone give me an example where they have used a unit rate in their everyday life?"</i> 	<ul style="list-style-type: none"> Prompts more than one student to share experiences that they see as connected to the lesson. AND Makes an explicit connection between the lesson and experiences shared by more than one student. <i>"Does anyone else have a different example of how a unit rate is used in your everyday life?"</i>
Frequency rating	<input type="checkbox"/> Once (1 point)	<input type="checkbox"/> Limited (2 points)	<input type="checkbox"/> Consistently (3 points)
<input type="checkbox"/> Did not occur (0 points)	<ul style="list-style-type: none"> Occurs exactly one time during the lesson. 	<ul style="list-style-type: none"> Occurs exactly two to three times during the lesson. OR Occurs more than three times but is clustered only during one part of the lesson and not revisited. 	Occurs more than three times throughout the course of the lesson.

Notes/evidence (Provide at least one note for each observed behavior.)

Dimension	A2. Supports students by allowing multiple representations and approaches		
Definition	The teacher shares how problems within a lesson can be represented or solved in multiple ways.		
Quality rating	<input type="checkbox"/> Low (1 point)	<input type="checkbox"/> Medium (2 points)	<input type="checkbox"/> High (3 points)
<input type="checkbox"/> Not applicable (0 points)	<ul style="list-style-type: none"> Presents more than one representation or approach to solving the problem. <p><i>“This is what the pattern we just discussed would look like on a graph.”</i></p>	<ul style="list-style-type: none"> Presents more than one representation or approach to solving the problem. <p style="text-align: center;">AND</p> <ul style="list-style-type: none"> Shares one or more alternative representations or approaches to solving the problem that come from a student. <p><i>“I showed you one way of showing the pattern as a picture. Taylor represented it in a different way, like this.”</i></p>	<ul style="list-style-type: none"> Presents more than one representation or approach to solving the problem. <p style="text-align: center;">AND</p> <ul style="list-style-type: none"> Solicits a student to share one or more alternative representations or approaches to solving the problem. <p><i>“Taylor showed us how they solved the problem. Did someone else solve it in a different way that they want to share?”</i></p>
Frequency rating	<input type="checkbox"/> Once (1 point)	<input type="checkbox"/> Limited (2 points)	<input type="checkbox"/> Consistently (3 points)
<input type="checkbox"/> Did not occur (0 points)	<ul style="list-style-type: none"> Occurs exactly one time during the lesson. 	<ul style="list-style-type: none"> Occurs exactly two to three times during the lesson. <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> Occurs more than three times but is clustered only during one part of the lesson and not revisited. 	<ul style="list-style-type: none"> Occurs more than three times throughout the course of the lesson.

Notes/evidence (Provide at least one note for each observed behavior.)

Dimension	A3. Values student thinking and voice		
Definition	The teacher provides opportunities for students to share their work and voice their thinking, and incorporates these into their teaching of the lesson.		
Quality rating	<input type="checkbox"/> Low (1 point)	<input type="checkbox"/> Medium (2 points)	<input type="checkbox"/> High (3 points)
<input type="checkbox"/> Not applicable (0 points)	<ul style="list-style-type: none"> Acknowledges student thinking and ideas without evaluating if they are correct or not. <i>“Tamara just gave us her reasoning for why she got her answer.”</i> 	<ul style="list-style-type: none"> Acknowledges student thinking and ideas without evaluating if they are correct or not. AND Prompts students to discuss each other’s thinking and reasoning. <i>“Tamara and Marcus have both shared their answers and reasoning. Let’s discuss the ways in which their answers are the same or different.”</i> 	<ul style="list-style-type: none"> Acknowledges student thinking and ideas without evaluating if they are correct or not. AND Prompts students to discuss each other’s thinking and reasoning. AND Prompts students to respond to each other’s thinking and reasoning. <i>“Can someone tell me if they got the same answer or a different answer than Tamara, and explain their reasoning?”</i>
Frequency rating	<input type="checkbox"/> Once (1 point)	<input type="checkbox"/> Limited (2 points)	<input type="checkbox"/> Consistently (3 points)
<input type="checkbox"/> Did not occur (0 points)	<ul style="list-style-type: none"> Occurs exactly one time during the lesson. 	<ul style="list-style-type: none"> Occurs exactly two to three times during the lesson. OR Occurs more than three times but is clustered only during one part of the lesson and not revisited. 	<ul style="list-style-type: none"> Occurs more than three times throughout the course of the lesson.

Notes/evidence (*Provide at least one note for each observed behavior.*)

Dimension	A4. Promotes collaboration and community		
Definition	Teacher provides students the opportunity to work together and build from one another's knowledge and experiences, and to share their work with the class.		
Quality rating	<input type="checkbox"/> Low (1 point)	<input type="checkbox"/> Medium (2 points)	<input type="checkbox"/> High (3 points)
<input type="checkbox"/> Not applicable (0 points)	<ul style="list-style-type: none"> Provides at least one opportunity for students to work together during class. <p><i>"Let's work on this together in groups."</i></p>	<ul style="list-style-type: none"> Provides multiple opportunities for students to work together during class. <p>AND</p> <ul style="list-style-type: none"> Gives students the opportunity to share work from their group with the broader class. <p><i>"Let's get back into groups. When we are done, one person from each group is going to share out the group's answers."</i></p>	<ul style="list-style-type: none"> Provides multiple opportunities for students to work together during class. <p>AND</p> <ul style="list-style-type: none"> Gives multiple students the opportunity to share work from their group with the broader class. <p>AND</p> <ul style="list-style-type: none"> Students have an opportunity to explain their group's thinking to the broader class. <p><i>"After we are done with group work, each group will present their approach, and the rest of the class will have a chance to ask them questions."</i></p>
Frequency rating	<input type="checkbox"/> Once (1 point)	<input type="checkbox"/> Limited (2 points)	<input type="checkbox"/> Consistently (3 points)
<input type="checkbox"/> Did not occur (0 points)	<ul style="list-style-type: none"> Occurs exactly one time during the lesson. 	<ul style="list-style-type: none"> Occurs exactly two to three times during the lesson. <p>OR</p> <ul style="list-style-type: none"> Occurs more than three times but is clustered only during one part of the lesson and not revisited. 	<ul style="list-style-type: none"> Occurs more than three times throughout the course of the lesson.
Notes/evidence (<i>Provide at least one note for each observed behavior.</i>)			

Domain summary

Observed strengths:

Areas for growth:

Overall feedback:

Computational thinking definitions

Note. Behaviors in this domain must incorporate at least one of the following CT skills.

Code	CT problem-solving strategy	Definition ^a
PR	Pattern recognition	Observing and identifying patterns, trends, and regularities in data, processes, or problems
AB	Abstraction	Identifying the general principles and properties that are important and relevant to the problem
DC	Decomposition	Breaking down data, processes, or problems into smaller, meaningful, and more manageable parts
DB	Debugging	Reviewing solutions to troubleshoot errors or improve the solution
AL	Algorithms	Developing step-by-step instructions for solving a problem and similar problems

CT is computational thinking.

a. Definitions adapted from Dong, Y., Catete, V., Jocius, R., Lytle, N., Barnes, T., Albert, J., Joshi, D., Robinson, R., & Andrews, A. (2019). PRADA: A practical model for integrating computational thinking in K–12 education. In *Proceedings of the 50th ACM technical symposium on computer science education* (pp. 906–912).

Dimension	B1. Frames the lesson around CT		
Definition	Teachers set up the activity in a way that provides students with an opportunity to engage in CT.		
Quality rating	<input type="checkbox"/> Low (1 point)	<input type="checkbox"/> Medium (2 points)	<input type="checkbox"/> High (3 points)
<input type="checkbox"/> Not applicable (0 points)	<ul style="list-style-type: none"> Introduces a problem or task that includes an explicit opportunity for students to engage in CT. <p><i>“Today we are going to be working on recognizing patterns.”</i></p>	<ul style="list-style-type: none"> Introduces a problem or task that includes an explicit opportunity for students to engage in CT. <p>AND</p> <ul style="list-style-type: none"> States how students can use a CT problem-solving strategy during the current lesson. <p><i>“Today we are going to use patterns to come up with a rule for solving problems that involve multiplying fractions.”</i></p>	<ul style="list-style-type: none"> Introduces a problem or task that includes explicit opportunities for students to engage in CT. <p>AND</p> <ul style="list-style-type: none"> States how students can use a CT problem-solving strategy during the current lesson. <p>AND</p> <ul style="list-style-type: none"> Explains how students can apply a CT strategy in other lessons or contexts. <p><i>“Recognizing patterns can help come up with rules that always work. Today, we are going to use patterns to come up with a rule for solving problems that involve multiplying fractions.”</i></p>
Frequency rating	<input type="checkbox"/> Once (1 point)	<input type="checkbox"/> Limited (2 points)	<input type="checkbox"/> Consistently (3 points)
<input type="checkbox"/> Did not occur (0 points)	<ul style="list-style-type: none"> Occurs exactly one time during the lesson. 	<ul style="list-style-type: none"> Occurs exactly two to three times during the lesson. <p>OR</p> <ul style="list-style-type: none"> Occurs more than three times but is clustered only during one part of the lesson and not revisited. 	<ul style="list-style-type: none"> Occurs more than three times throughout the course of the lesson.
Notes/evidence (<i>Provide at least one note for each observed behavior.</i>)			
<i>PR</i>			<i>DB</i>
<i>AB</i>			<i>AL</i>
<i>DC</i>			

Dimension B2. Prompts students to use CT

Definition Teacher encourages students as they work on a problem (verbally or through resources) to use an approach that incorporates CT.

Quality rating	<input type="checkbox"/> Low (1 point)	<input type="checkbox"/> Medium (2 points)	<input type="checkbox"/> High (3 points)
<input type="checkbox"/> Not applicable (0 points)	<ul style="list-style-type: none"> Suggests students try a particular CT strategy at a specific point in their work. <p><i>“You should try breaking down the problem into smaller parts.”</i></p>	<ul style="list-style-type: none"> Suggests students try a particular CT strategy at a specific point in their work. <p>AND</p> <ul style="list-style-type: none"> Uses questioning to help students notice opportunities to use a CT strategy. <p><i>“Are there any smaller parts of the problem that you could solve first?”</i></p>	<ul style="list-style-type: none"> Suggests students try a particular CT strategy at a specific point in their work. <p>AND</p> <ul style="list-style-type: none"> Uses questioning to help students notice opportunities to use a CT strategy. <p>AND</p> <ul style="list-style-type: none"> Asks students to evaluate the utility of a CT strategy for certain scenarios. <p><i>“Would it be helpful to break the problem into smaller parts here? Why or why not?”</i></p>

Frequency rating	<input type="checkbox"/> Once (1 point)	<input type="checkbox"/> Limited (2 points)	<input type="checkbox"/> Consistently (3 points)
<input type="checkbox"/> Did not occur (0 points)	<ul style="list-style-type: none"> Occurs exactly one time during the lesson. 	<ul style="list-style-type: none"> Occurs exactly two to three times during the lesson. <p>OR</p> <ul style="list-style-type: none"> Occurs more than three times but is clustered only during one part of the lesson and not revisited. 	<ul style="list-style-type: none"> Occurs more than three times throughout the course of the lesson.

Notes/evidence (Provide at least one note for each observed behavior.)

PR
AB
DC

DB
AL

Dimension B3. Highlights when students use CT

Definition Teacher encourages students as they work on a problem (verbally or through resources) to use an approach that incorporates CT.

Quality rating	<input type="checkbox"/> Low (1 point)	<input type="checkbox"/> Medium (2 points)	<input type="checkbox"/> High (3 points)
<input type="checkbox"/> Not applicable (0 points)	<ul style="list-style-type: none"> Highlights a specific CT problem-solving strategy a student used. <p><i>“I like how you made a drawing to show the important information in the problem.”</i></p>	<ul style="list-style-type: none"> Gets students to discuss how using a specific CT problem-solving strategy could be helpful. <p>AND</p> <ul style="list-style-type: none"> Identifies other applications and situations where this CT problem-solving strategy can be used. <p><i>“I like how you made a drawing to show the important information in the problem. Let’s do that again on the next problem.”</i></p>	<ul style="list-style-type: none"> Gets students to discuss how using a specific CT problem-solving strategy could be helpful. <p>AND</p> <ul style="list-style-type: none"> Asks students to identify other applications and situations where these CT problem-solving strategies can be used. <p><i>“I like how Monica made a drawing to show the important information in the problem. Can we find another problem where that might be helpful?”</i></p>
Frequency rating	Once (1 point)	Limited (2 points)	Consistently (3 points)
<input type="checkbox"/> Did not occur (0 points)	<ul style="list-style-type: none"> Occurs exactly one time during the lesson. 	<ul style="list-style-type: none"> Occurs exactly two to three times during the lesson. <p>OR</p> <ul style="list-style-type: none"> Occurs more than three times but is clustered only during one part of the lesson and not revisited. 	<ul style="list-style-type: none"> Occurs more than three times throughout the course of the lesson.

Notes/evidence (Provide at least one note for each observed behavior.)

PR

DB

AB

AL

DC

Domain B: Computational thinking summary

Observed strengths:

Areas for growth:

Overall feedback:

Appendix C3. Templates for ENACT Classroom Posters and Student Bookmarks

Pattern Recognition

Looking for ways that problems or solutions are similar or different to help me solve other related problems

What does this problem make me think of?

How are these problems and their solutions alike? How are they different?

Do the similarities give me any ideas about how I can solve this or other problems?

Pattern Recognition

Looking for ways that problems or solutions are similar or different to help me solve other related problems

What does this problem make me think of?

How are these problems and their solutions alike? How are they different?

Do the similarities give me any ideas about how I can solve this or other problems?

Abstraction

Identifying and representing the important information in a problem or situation

What is this problem asking me to do?

What information should I focus on?

Can I use a diagram or picture to show the important information?

Abstraction

Identifying and representing the important information in a problem or situation

What is this problem asking me to do?

What information should I focus on?

Can I use a diagram or picture to show the important information?

Decomposition

Breaking a complex problem into smaller parts that are easier to address.

What are the different parts of this problem?

Are there any parts that are familiar or easy?

Is there more than one way I could break this problem into parts?

Decomposition

Breaking a complex problem into smaller parts that are easier to address.

What are the different parts of this problem?

Are there any parts that are familiar or easy?

Is there more than one way I could break this problem into parts?

Debugging

Finding and fixing mistakes to improve my work

Does my answer make sense for this problem?

How can I review my thinking or my strategy?

What changes can I make to improve my work?

Debugging

Finding and fixing mistakes to improve my work

Does my answer make sense for this problem?

How can I review my thinking or my strategy?

What changes can I make to improve my work?

Algorithms

Developing and using systematic, step-by-step approaches to problems

What steps did I use to solve this problem?

Could I use the same steps on another problem?

How could I communicate my steps to someone else?

Algorithms

Developing and using systematic, step-by-step approaches to problems

What steps did I use to solve this problem?

Could I use the same steps on another problem?

How could I communicate my steps to someone else?

Pattern Recognition

Looking for ways that problems or solutions are similar or different to help me solve other related problems

What does this problem make me think of?

How are these problems and their solutions alike? How are they different?

Do the similarities give me any ideas about how I can solve this or other problems?

Abstraction

Identifying and representing the important information in a problem or situation

What is this problem asking me to do?

What information should I focus on?

Can I use a diagram or picture to show the important information?

Decomposition

Breaking a complex problem into smaller parts that are easier to address.

What are the different parts of this problem?

Are there any parts that are familiar or easy?

Is there more than one way I could break this problem into parts?

Debugging

Finding and fixing mistakes to improve my work

Does my answer make sense for this problem?

How can I review my thinking or my strategy?

What changes can I make to improve my work?

Algorithms

Developing and using systematic, step-by-step approaches to problems

What steps did I use to solve this problem?

Could I use the same steps on another problem?

How could I communicate my steps to someone else?

Introduction to Abstraction and Pattern Recognition

Ordering octopi (15–20 minutes)

This activity will introduce students to two big ideas in computational thinking (CT): abstraction and pattern recognition.

Directions

1. Distribute one set of cards to each pair of students. If you have not already cut the cards out, have students cut them out.
2. Tell students that their task is to work with a partner to put the cards in order. Part of their job will be to decide what it means for the cards to be in order.
3. Give partnerships time to work on the task. As they decide how to order the cards, have them practice explaining how they decided on the order of the cards. Circulate and observe as students work. Possible criteria for ordering the cards might be:
 - a. The number of octopi on the card (most to least or least to most).
 - b. The size of the octopi on the card (biggest to smallest or smallest to biggest).
 - c. The color of the octopi on the card (lightest to darkest, darkest to lightest, or rainbow order).
4. When partnerships have decided on their orderings, ask several partnerships to share their thinking. Choose partnerships that used different criteria for ordering. If all partnerships ordered the cards in the same way (such as by the number of octopi), then encourage students to think of other ways they could be ordered and work as a class to order a set of cards in different ways.
6. Ask students to share what they noticed about the cards when they first looked at them. As students share what they noticed about the cards, ask follow-up questions to help them restate their thinking in terms of patterns.

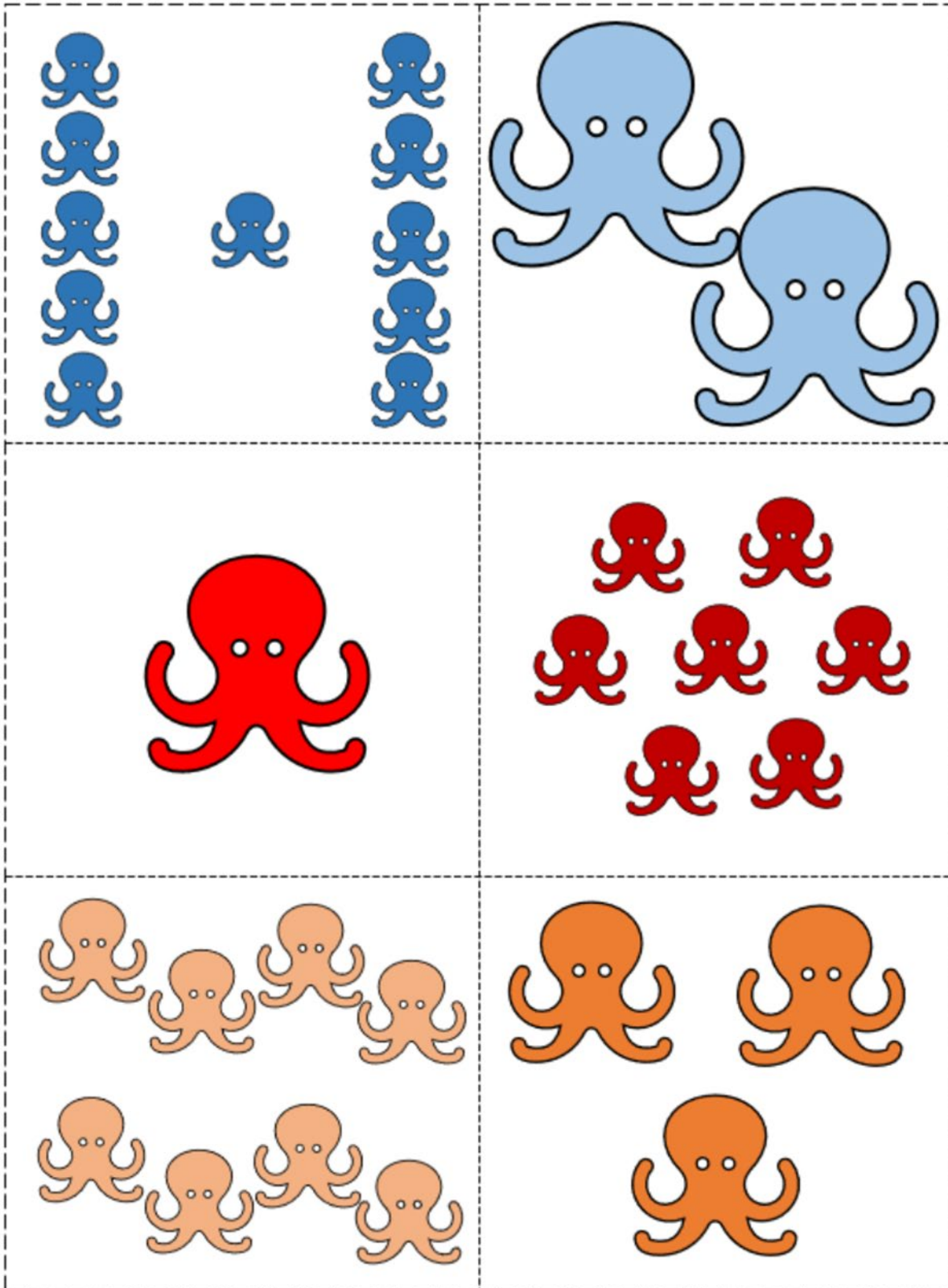
Materials: One set of octopus cards for each pair of students (shown after the directions). You may wish to print them on cardstock and cut them out ahead of time. Otherwise, students will need scissors.

It will be helpful to print the octopus cards in color. If this is not possible, students can still complete the activity. Color will not be available as a criterion for ordering, but students could still order the cards by the number or size of the octopi.

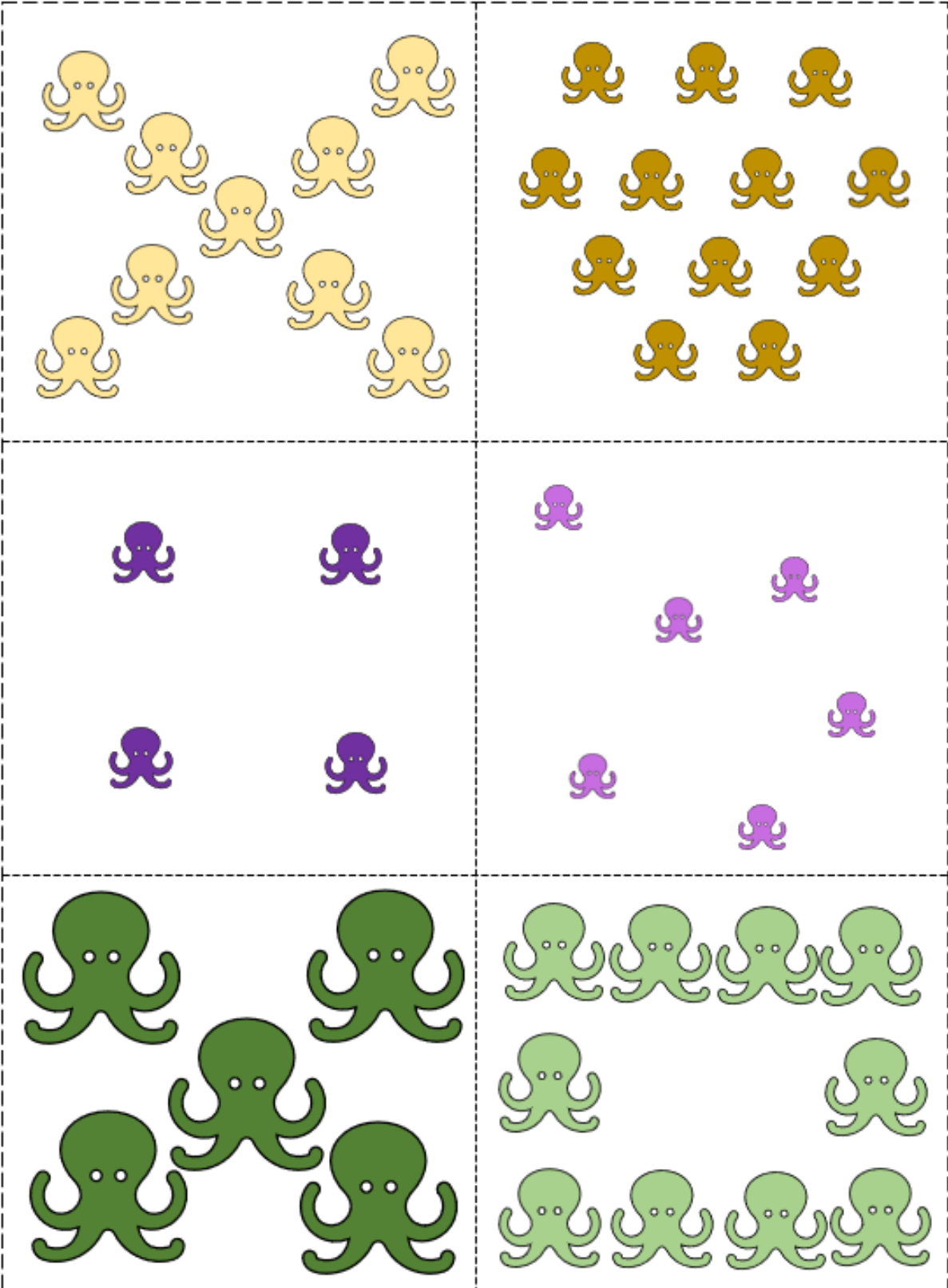
For example:

- a. If a student says that they noticed there were different numbers of octopi on the cards, ask: What did you notice about the numbers? Were they random numbers? Did some cards have the same number or were they all different?
 - b. If a student says that they noticed there were different colors on the cards, ask: Can you say more about the colors? What did you notice about light and dark colors? What colors were there?
5. Explain that as students looked at the cards, they noticed **patterns**, or things that were similar or changing across the cards. Explain that patterns are useful in mathematics because they can provide clues for how to solve a problem. This year, students will use a CT strategy called **pattern recognition** to help them solve math problems. Point out that they already have had some practice recognizing patterns in the octopus' cards, and they will practice getting better at this skill during the school year.
 6. Next, ask students to share how they decided how to order the cards. Ask: If you decided to use the number of octopi to order the cards, did you have to pay attention to the size of the octopi as you put them in order? Why or why not? Explain that when they chose how to order the cards, students identified an important piece of information they wanted to focus on. They didn't have to pay attention to all the features of the cards after this. They could just focus on the size, color, or number of the octopi. Ask: How did focusing on just one kind of information on the cards make the task of putting them in order easier?
 7. Explain that when students identified what information was most important to focus on, they were doing a CT strategy called **abstraction**. Skilled problem solvers use this skill a lot to help them simplify problems. Students will have lots of practice this year identifying important information and representing that information in ways that are easy to see and explain.

Octopus cards, page 1



Octopus cards, page 2



Introduction to Debugging, Decomposition, and Algorithms

Drawing from directions (15–20 minutes)

This activity will introduce students to three big ideas in computational thinking (CT): debugging, decomposition, and algorithms.

Directions

1. Divide your class into two groups. Show each group one of your two chosen designs. Students should not see the design used by the other group.
2. Tell students that their task is to write directions for how to draw their design. Someone who has not seen the design should be able to follow their directions to reproduce the design.
3. When students are finished writing their directions, have each student partner with someone from the other group. Students exchange directions. Without looking at the original designs, students should follow their partners' directions closely to create a drawing.
4. Students return the directions, along with the drawings they created, to their partners. Together with their partners, students compare the drawings with the original design. They talk together about ways they could change the directions so that the drawing produced would end up closer to the original design.
5. After students discuss improvements to their directions, bring the class back together for a discussion. Ask questions such as the following:
 - a. What were some differences between the original design and your partner's drawing?
 - b. What improvements did you make in your directions?
6. Explain that when students compared the drawings and made improvements to their directions, they were doing a kind of CT strategy called **debugging**. Debugging is a kind of problem solving where you check whether the outcome of your work matches what you intended. If the outcome or solution doesn't make sense or look like you intended, then there is a **bug**, or error, in the solution. When you try to figure out the bug and fix it, you are debugging. Tell students that they will be doing lots of debugging in math class this year, and that looking for and fixing errors is a normal and important part of being a good problem solver.

Materials: Two simple line drawings or designs. Examples are given below the activity directions. You can make adjustments to suit the needs or interests of your class.

7. Next, ask students to talk to their partners about how they went about creating their directions. Questions that can guide their discussion include:
 - a. What part of the design did you decide to write directions for first?
 - b. Did you think about the whole design at once, or think about it in pieces?
8. Have a few volunteers describe how they went about writing their original directions. Expect that some students will discuss handling one part of the design at a time. Explain that these students were doing another kind of CT strategy called **decomposition**. Decomposition is a process of breaking a complex problem or situation into parts to make it easier to solve. Ask students to discuss the following questions:
 - a. How might breaking a design into parts make writing directions easier?
 - b. What are the different ways you could decompose the design?

Tell students that they will use **decomposition** as a strategy for solving challenging math problems this year. Explain that skilled problem solvers use this strategy to get started on and solve challenging problems.

9. Last, ask students to imagine that they had more time to debug and test their directions, and that they ended up with a very clear set that helped anyone produce the design exactly. Ask students to share their experiences by following detailed directions, such as when they follow recipes or directions for assembling a model or toy. Ask:
 - a. Why is it useful to have a clear set of steps for completing a task?
10. Explain that a clear, step-by-step process for solving a problem is called an **algorithm**. Developing and following algorithms is another important kind of CT strategy that students will use in math class this year. Tell students that they will be doing a lot of thinking about how to create algorithms and why algorithms work. This will help them become powerful problem solvers.

(A sample design is on the next page.)

Sample design

