6.1 Overview

Open response problems are tasks that have multiple solution paths and often more than one solution. They offer students rich opportunities to solve engaging problems using their own strategies and reasoning.

Research conducted by the Mathematics Assessment Collaborative has demonstrated that the use of complex open response problems “significantly enhances student achievement both on state standardized multiple choice achievement tests and on more complex performance based assessments” (Paek & Foster, 2012, p. 11). Learning through problem solving has been at the center of Everyday Mathematics beginning with the first edition. This edition of Everyday Mathematics builds on this tradition by featuring challenging problems in Open Response and Reengagement lessons and the inclusion of open response problems in assessments.

Open Response and Reengagement lessons are two-day lessons that include a day for students to solve a challenging problem, followed by a day for students to analyze and learn from the solutions of others and then revise their own work from the first day. Except for the first section of Kindergarten, there is one Open Response and Reengagement lesson in each unit or section of Grades K–6 Everyday Mathematics. In Kindergarten, students are introduced to the process of analyzing and learning from others’ work, but they are not expected to revise their initial responses.

Open Response Assessments appear in Progress Check lessons in odd-numbered units in Grades 1–6. The tasks in the Open Response Assessments are similar to those in Open Response and Reengagement lessons, but they do not include a second day of student reengagement with the problem.
6.2 Open Response and Reengagement Lessons

Open Response and Reengagement lessons provide students with the following opportunities:

- **To solve complex problems.** Through the open response problems, all students have multiple opportunities to persevere with challenging tasks, communicate their thinking, and learn from the mathematical thinking of others. These problems differ from exercises, which often provide practice for previously learned skills and are typically found in practice activities and games. Open response problems offer opportunities for students to learn new concepts through the problem solving process.

- **To promote explicit attention to the mathematical practices.** The Open Response and Reengagement lessons systematically address the Common Core’s Standards for Mathematical Practices (SMP) by highlighting a different mathematical practice in each Open Response and Reengagement lesson within each grade level. For each lesson, three to four Everyday Mathematics Goals for Mathematical Practice (GMP) are emphasized. One of these targeted GMPs is the focus for class discussion during reengagement and for assessment. To highlight the GMPs that support development of problem-solving skills, the targeted GMPs in each lesson in Grades K–5 include one of the six GMPs within SMP1.

- **To differentiate instruction through challenging mathematical tasks.** Because the open response problems can be solved with multiple strategies and tools, they are accessible to diverse learners. Using an analysis of class performance on the task as an instructional guide, teachers can address students’ needs during reengagement. In the reengagement discussion, students make sense of others’ thinking by interpreting strengths, weaknesses, or misconceptions in their peers’ solutions. Following the discussion, students apply these new understandings to revise their work. This approach provides struggling students with new opportunities to access the mathematics, while creating an expanded, high cognitive demand task for students who performed well on the original problem as they interpret the mathematical thinking of others.

Teachers can approach Open Response and Reengagement lessons in three parts. First, on Day 1 teachers introduce the problem, encourage students to persevere in solving it, and observe students’ use of the mathematical practices. Second, teachers examine students’ responses from Day 1 and identify sample work that can be used to focus student attention on the content and practices addressed in the lesson. Teachers then use the chosen work samples to develop discussion questions that highlight use of the focus mathematical practice as well as misconceptions in need of attention. Third, on Day 2 teachers use the work samples and associated questions to facilitate a reengagement discussion. This discussion provides an extended opportunity for students to think through the mathematics of the problem, see how other students engage in the practices, and develop ideas for revising their work.
6.2.1 Preparing for Day 1

The Before You Begin section of the Lesson Opener often recommends that teachers solve the open response problem themselves prior to the lesson. While working through the problem, teachers should consider the following:

- strategies students are likely to use (both correct and incorrect);
- mathematical misconceptions that may affect students’ work;
- questions to support students’ perseverance as they work through the problem; and
- ways to highlight the focus GMP that the problem addresses.
Other features of Open Response and Reengagement lessons that are helpful in preparing for Day 1 include the following:

- **Lesson Openers for Day 1 and Day 2** give information for preparation that should be done before the lesson and identify the content and mathematical practices addressed in the lesson.

- A **professional development note** provides mathematical background on the focus GMP.

- An **evaluation rubric** helps teachers evaluate student work and make appropriate connections between the problem and the focus GMP.

- **Samples of student work** in the Teacher’s Lesson Guide and online help teachers anticipate student performance on the problem and provide examples of work that might be used in the reengagement discussion.

For more information and the location of the rubrics, see Section 6.2.3 Getting Ready for Day 2.
### 6.2.2 Day 1: Open Response

The Focus section of Day 1 of the Open Response and Reengagement lessons consists of three parts: Math Message, Math Message Follow-Up, and Solving the Open Response Problem.

**Math Message**

This section provides an entry point for teaching the lesson that provides an opportunity for students to work with the content and practices addressed in the open response problem. Student performance on the Math Message provides useful information that teachers can use to determine the amount and type of scaffolding that will be needed to prepare students for the open response problem.

**Math Message Follow-Up**

This section actively engages students in a discussion of the Math Message. This discussion provides an opportunity for students to recall their understanding of the content or practices that they will use to solve the open response problem and allows teachers to address any misconceptions or weaknesses they observed. This discussion also helps students practice talking about problem-solving strategies and solutions, which they will do again during Day 2 of the lesson.

**Solving the Open Response Problem**

Each Open Response and Reengagement lesson provides suggestions for introducing the problem, information on the mathematical concepts and context of the problem, prompts to focus students on the target content and practices, and suggestions for tools to make available to students for solving the problem. Because Open Response and Reengagement lessons do not include Differentiation Options pages, these lessons include English Language Learner notes that offer suggestions for introducing the vocabulary in the problem and Adjusting the Activity notes that provide information on how to...
help struggling students begin solving the problem and, when appropriate, how to challenge students by extending the problem. Teachers should take care not to “over-teach” this part of the lesson, since students need the chance to struggle a bit, make mistakes, and solve the problem in a way that makes sense to them. See example from the Grade 2 Teacher’s Lesson Guide on the following page.

The Open Response Problems are available in print as Math Masters or digitally in the Student Learning Center. Since the digital problems are often displayed on multiple screens, it may be preferable for students to work on print copies of the Math Masters pages. This will allow for easy viewing of all the problems simultaneously, and allow students room to both show their work and explain their thinking fully.

Before students begin the open response problem, teachers should read through the problem with students and make sure they understand what is expected and what tools and manipulatives are available. Once students have started working, teachers can use discussion prompts to monitor student progress and to clarify the problem when necessary. If students are having difficulty, the teacher should ask them to explain what they are doing and why in order to understand their thinking about the problem. Teachers, however, should try to minimize how much they intervene. Allowing students to use their own strategies and tools will produce better learning in the long run and a more robust and informative range of responses on the problem.

Students click on the Activity Tile “Solve the Problem and Revise” to access the screen for the Open Response problem on Day 1. Students will open the same tile on Day 2 to revise their work.
Students should be encouraged to work in partnerships and small groups, but students should record their own solutions. The resulting diversity in student work provides an essential element in planning the reengagement discussion. Student performance on challenging open response problems is “a gold mine of information that can drive significant learning for teachers as well as students” (Foster & Poppers, 2009, p. 8).

Solving the Open Response Problem section, Grade 2 Lesson 4-6 with open response problem from Math Masters, Grade 2 Lesson 4-6
6.2.3 Getting Ready for Day 2

Using the "gold mine" of student work to guide instruction is the central idea of reengagement. This section suggests strategies for using student work in planning and implementing a reengagement discussion.

Using the Task-Specific Rubric

An essential first step in planning an effective and engaging reengagement discussion is to evaluate class performance on the problem. Teachers can use the rubric provided in the Lesson Opener for Day 2 in the Teacher's Lesson Guide to guide them in evaluating student work. In the Teacher Center, the rubric appears in the Assessment Check-In box. Look for the yellow tile, accessible through the Activities view. All rubrics were developed from an analysis of student work collected during field testing. The rubrics are task-specific so teachers can anticipate the range of student performance and analyze the responses based on the lesson's focus GMP.
Task-specific rubric used to evaluate student work in preparation for Day 2, Grade 1 Lesson 2-5

From the Activities tile view, click on the yellow tile to access the rubric on the Revising Work screen, as shown for Grade 4, Lesson 2-6.

Teachers can use the rubric to sort student work into three groups: work that clearly meets expectations based on the description in the rubric, work that does not meet expectations, and work that teachers are undecided about. For guidance in using the rubric to sort student work, teachers can refer to the evaluated sample student work in the Teacher’s Lesson Guide and the online work samples. The following questions should be kept in mind while sorting student work and preparing for the reengagement discussion:

- Do most papers show evidence that students can correctly solve the problem and meet expectations for the GMP? Are there common strengths and areas of understanding?
- Are there common misconceptions about the content or GMP that can be addressed in the reengagement discussion? Are there common deficiencies in students’ strategies, explanations, and justifications?

For more information on using rubrics, see Section 94.1 Rubrics for Evaluating Mathematical Practices.
Using Student-Friendly Rubrics

Student-friendly rubrics offer another approach for organizing a reengagement discussion. In Grades 3–5, one Open Response and Reengagement lesson includes an example of a student-friendly rubric and a description of how it can be used in a reengagement. These rubrics use language that is easily understood by students to describe criteria for meeting expectations on key practices or content in the problem. By clearly defining specific performance goals, student-friendly rubrics provide a structure that students can use to analyze their peers' work.

**Rubric for Estimating Costs**

<table>
<thead>
<tr>
<th>Goal: Explain your mathematical thinking clearly and precisely.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meets Expectations</td>
</tr>
<tr>
<td>Shows the close-but-easier numbers used to make estimates.</td>
</tr>
<tr>
<td>Shows how to make an estimate of how much money the art club has left over.</td>
</tr>
<tr>
<td>Exceeds Expectations</td>
</tr>
<tr>
<td>Explains that Ann's answer of $67 is NOT reasonable because it is not close to an estimated leftover amount of $40.</td>
</tr>
</tbody>
</table>

Student-friendly rubric from Grade 3 Lesson 3-2
Typically, teachers select three samples of student work that represent a range of performance on the problem. After distributing the selected work, teachers use one of the samples to demonstrate that in order for work to meet expectations, it must clearly meet the criteria in the rubric. Students then work with partners to analyze the other two samples.

Once partnerships have completed their analysis, the class shares their findings. In the discussion, students explain how they decided whether a work sample meets or does not meet specific criteria in the rubric. In field tests, student-friendly rubrics were found to be effective in providing structure and vocabulary for students to use in analyzing and discussing their peers’ work.

**Using the Reengagement Planning Form**

The Reengagement Planning Form is a Teaching Aid Master that can assist teachers in using information from their analysis of student work and organizing the reengagement discussion. The focus content and practice standards are at the top of the form, so teachers can keep these in mind as they look for strengths and weaknesses in student performance. Teachers can then use the second section of the form to determine specific issues they want to address in the reengagement discussion. Then they can select at least one sample of student work that addresses each issue and develop questions for discussion. Work samples might include:

- clear examples of well-executed solutions or misconceptions that can generate discussion of the key mathematical ideas or the focus GMP addressed in the problem;
- examples of a common error that can be used to discuss ways to correct the error and learn from it; and
- interesting or unique solutions that show different strategies or tools for solving the problem.
Example of a Reengagement Planning Form completed by a teacher for Grade 1 Lesson 2-5

Planning a Follow-Up Discussion

Preparing discussion questions that will actively engage students in making sense of the selected student work is at the heart of reengagement. Successful reengagement discussions offer powerful opportunities for students to refine and deepen their understanding of the lesson’s mathematical content and practices.
Planning a Follow-Up Discussion section, Grade 1 Lesson 2-5 and from the Teacher Center, Grade 3 Lesson 1-6

Sample student work collected from field tests along with associated sample discussion questions are provided in this section of the Open Response and Reengagement lessons. These examples help teachers consider how they might engage students in the focus content and practice standards using their students’ work or the sample work provided. Possible strategies for organizing the discussion include the following:

- **Presenting a partially correct or incomplete response.** Students make sense of others’ thinking used to solve the problem and identify any good ideas they see in the solution. Then students identify any mistakes or misunderstandings in the work and suggest ways to improve it.

- **Presenting two correct and complete responses with different solution strategies.** Pairs of students compare and contrast the two solutions, then partnerships share their thinking with the class.

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**Open Response and Reengagement**
• **Presenting a solution that clearly shows effective use of the focus GMP and one that does not.** Students compare and contrast the two different solutions based on the GMP and make suggestions for revisions.

Students benefit most when reengagement discussions focus on sample work from their own class. When they are discussing their work and the work of their peers, students are more engaged because they see themselves as active participants in the learning process. An ePresentations note gives instructions for uploading and viewing student work from the classroom. The sample student work in the *Teacher’s Lesson Guide* is also available online for use in discussions.

### 6.2.4 Day 2: Reengagement

The Focus section of Day 2 of the Open Response and Reengagement lessons consists of three parts: Setting Expectations, Reengaging in the Problem, and Revising Work.

#### Setting Expectations

This part of the lesson provides suggestions for teachers to briefly review the mathematics of the open response problem from Day 1, discuss the focus GMP, and establish expectations for a correct and complete solution.

**Establishing Guidelines for Reengagement.** To promote an environment that supports constructive class discussions, the first Open Response and Reengagement lesson in each grade describes how teachers can develop general discussion guidelines for the class to use throughout the year. Teachers can solicit suggestions from the class and include items that they feel are important. Early in the year, this list may only include a few items so as not to overwhelm students. Teachers and students can add to the list throughout the year and refer to it during any group discussion. See sample poster in the margin.

Modeling or having students role-play situations based on one or more of the guidelines on the poster can help reinforce appropriate behavior during discussions. For example, teachers may want to model how to disagree politely with a student’s solution or how to learn from a mistake.

Teachers can use sentence frames when modeling and encourage students to use appropriate language as they discuss other students’ work. Examples of sentence frames include:

- I noticed ________.
- I like how you ________.
- Could you explain ________?
- I disagree because ________.
- I don’t understand ________.
- I wonder why ________.
- I agree because ________.
- I also think ________.

#### Reengaging in the Problem

Teachers organize and facilitate the reengagement discussion based on the decisions they made while analyzing and selecting student work. Students analyze the presented student work and offer suggestions for revision. Because open response problems offer opportunities for multiple solution strategies, students may come up with inventive and creative paths to a solution, so teachers should be prepared to deviate from a planned discussion.
to follow these ideas as these are often the best opportunities for lively and generative discussions. However, discussion should always come back to the focus GMP.

**Revising Work**  
GRADE LEVEL: K, 1, 2, 3, 4, 5, 6

After discussing sample work, students revise their own work from Day 1. (Note: Open Response and Reengagement lessons in Kindergarten do not always include revision of students’ work.) Teachers should encourage students to use what they learned from the reengagement discussion to make corrections or improvements to their work. At the same time, students should be reminded that the solutions presented in the reengagement discussion are not the only possible strategies for solving the problem. Students should be encouraged to write clear and complete solutions that demonstrate their understanding of the focus GMP. Students should be encouraged to add to their work or write on a new copy rather than erase their original work. Teachers may wish to have students use colored pencils to make their revisions in order to help distinguish the original work from the revisions made after reengagement. In the Student Learning Center, the program automatically saves students’ work from Day 1. When students open the Solve the Problem and Revise tile on Day 2, they will see their work. Similar to the print, students can choose a different color for the writing tool when they begin revising.

### 6.2.5 Evaluating Student Performance

Each Open Response and Reengagement lesson has two sets of guidelines to evaluate students’ revised work for the content and mathematical practices addressed in the problem. The Assessment Check-In provides expectations for meeting the content standards and points to a qualitative, task-specific rubric to evaluate students’ performance on the focus GMP. While teachers may find the rubric useful for selecting student work and building a framework for the reengagement discussion, they should wait until after students have revised their work on Day 2 to assess their performance.

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**Assessment Check-In**

Select and present students' revised work. Examine the reengagement work based on the task discussion. For the content standards, there are expectations to help you determine if students are meeting the standards. The rubric is differentiated by levels of performance for GMPs.

For students who do not meet the expectations for the content standards, turn students’ attention to the mathematical practice expectations for the performance. Teachers can use the assessment check-in to identify any additional GMPs addressed in the lesson.

**Sample Children’s Work—Evaluated**

See the sample on the margin. This work meets expectations for the content standards by indicating understanding and showing the drawing. Notice how this work meets expectations for the mathematical practice because the child stated that Susan was correct and used the words drawing and center zero when shown evidence that focus also addressed the standard.

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**Assessment Check-In** and evaluated student work that meets expectations, based on the task-specific rubric on Grade 2 Lesson 4-6

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**Open Response and Reengagement**

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An evaluated work sample that meets expectations for both the content and practice standards is included in the Teacher’s Lesson Guide and Teacher Center for each Open Response and Reengagement lesson in Grades 1–6. Three additional evaluated work samples are available online. These samples represent a range of performance for the content and the practice standards. Each sample includes an explanation of the evaluation, making specific connections between the student’s work and expectations for the content and GMP based on the rubric.

Teachers can use data collected during the Open Response and Reengagement lessons in a variety of ways. When teachers return revised work to students, comments and evaluation of performance based on the task-specific rubric will provide useful feedback.

### 6.3 Open Response Assessments

**GRADE LEVEL**  [K | 1 | 2 | 3 | 4 | 5 | 6]

In Grades 1–6, Progress Check lessons in odd-numbered units include an Open Response Assessment on Day 2. Unlike the Open Response and Reengagement lessons, these problems do not include a second-day discussion and revision. The Open Response Assessments include expectations for meeting the content standards addressed in the assessment and task-specific rubrics for evaluating performance on the focus GMP. The Teacher’s Lesson Guide includes one sample of evaluated student work that meets expectations on the content and mathematical practice. Three additional evaluated work samples are available in the Teacher Center and the online Assessment Handbook. Although the Open Response Assessments do not include suggestions for a reengagement discussion, teachers should still take time to discuss the problem after students have had a chance to solve it.

### References