

Integrating Language Routines Into Instruction

Co-craft Questions and Problems

Students engage with the context of a problem before experiencing the pressure to produce answers.

Algebra 1 • Geometry • Algebra 2

Language Routine: Co-craft Questions

The purpose of this routine is for students to use conversation skills to generate, choose, and improve questions, problems and contextual situations. Students develop meta-awareness of the language used in mathematical questions.

Routine	
CO-CRAFT QUESTIONS	1. Situation Present students with a situation, context, or question stem without values included. 2. Write Students write possible mathematical questions that might be asked of the given situation, questions they may have about the situation, or assumptions they think are important. 3. Compare In pairs, students compare their questions. 4. Share Students share their questions with the class. This may include time for brief discussion. 5. Reveal Questions The actual questions students are expected to work on are chosen, and students begin to solve.
CO-CRAFT PROBLEMS	1. Create Pairs co-create new problems similar to a set of recently solved problems. 2. Solve Pairs solve their own co-crafted problem. 3. Exchange Students exchange problems with another pair, solve their new problem, and check their solution with the problem's original authors. SUPPORT Teacher can provide possible topics of interest to students or facilitate a whole-class brainstorm for two minutes prior to pairing students to co-craft problems.
CO-CRAFT SITUATIONS	1. Representation Teacher presents a mathematical representation, such as a graph, equation, function, or table with no labels. 2. Write Students write stories or describe situations that correspond to the mathematical representation. 3. Compare Students explain how events in their partner's story, or aspects of their partner's described situation, correspond to the specific parts of the mathematical representation. Students ask clarifying questions or request additional details during this step. 4. Revise Students revise their stories or situations, adding details or clarification where needed.

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From the Classroom: Co-Craft Situations

REPRESENT	After establishing understanding of linear inequalities, Ms. P poses this prompt to the class: "The answer is $15 \geq 4s - 1$. What might the situation be?"
WRITE AND COMPARE	Ms. P asks students to think to themselves for a minute before she prompts students to work with partners. Ms. P: "Okay, you have had about a minute to think to yourselves. You are going to find a partner, someone that is not seated at your table group. Your job is to write at least one problem context or situation for which this inequality is the answer. Write your situation on the 3 x 5 notecard once you've agreed on one." Ms. P circulates while students work with their partners. She uses the following questions to support student thinking and reasoning. Q What do you know about this inequality? Q What is the variable? What might it represent? Q What can you tell me about the value 15? Q Think back to our work yesterday. What types of situations did we encounter? Ms. P: "Alright, may I have your attention? Next, you and your partner will find another partner group and team up. Your task is to compare the two situations that you have created. What is the same? What is different? You will be turning in one paper for the four of you. Attach the notecards to that paper and then underneath them describe how the two situations compare. I'll put up some sentence starters on the screen for you to use, if you choose. Remember that you don't have to use my sentences; you can use your own if you'd like." On-screen sentence frames: • In both problems _____. • In the first problem _____, and in the second problem _____. • The problems are similar because _____. • The problems are different because _____.
REVISE	Ms. P collects these papers, and the following day she distributes them to different groups. She prompts groups by saying: "Remember yesterday when we wrote those problems for the inequality $15 \geq 4s - 1$? As a group of four, take a look at the two problems you have in front of you. You'll notice that these are not the ones that you wrote. Read and discuss the problems on your paper. Then, use the sticky notes you have on your desks to write any questions you have for the original authors." "After students work on their questions for 3-5 minutes, they return the papers and sticky notes to the original groups. Students then review the peer feedback and make any revisions or clarifications to their original two problem contexts before turning in their papers."

Integrating Language Routines Into Instruction

Critique, Correct, and Clarify

Students can start making sense of academic content and negotiate meaning in a language before they understand the language completely.

Algebra 1 • Geometry • Algebra 2

Language Routine: Critique, Correct, and Clarify

The purpose of this routine is to optimize output by giving students a piece of mathematical writing that is not their own to analyze, reflect on, and develop. The intent is to use an incorrect, incomplete, or ambiguous written argument or explanation which students improve upon by correcting errors and clarifying meaning, thereby advancing their own mathematical thinking and communication.

Routine	
PRESENT	Present a partial/broken argument, explanation, or solution method. Teacher can play the role of the student who produced the response and ask for help in fixing it. • <i>Given response could include a common error.</i> • <i>Given response should include an ambiguous term or phrase, or an informal way of expressing a mathematical idea.</i>
PROMPT	Prompt students to identify the error(s) or ambiguity, analyze the response in light of their own understanding of the problem, and work both individually and in pairs to propose an improved response.
SHARE	Pairs share their drafts of an improved response.
REFINE	Students refine their own draft responses..

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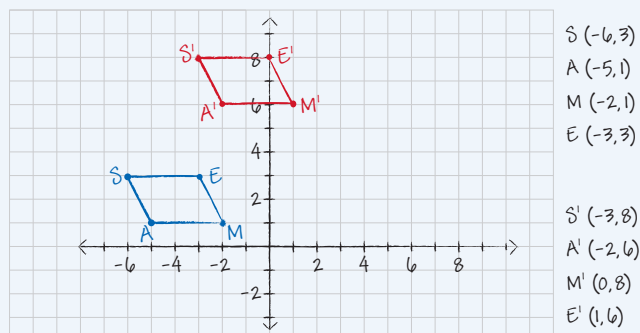
From the Classroom

PRESENT

Ms. L: "Let's look at this student's work. This is from one of my students in third period, and he is asking for our help. He knows he made a mistake, but isn't quite sure what he needs to do to fix it."

Quadrilateral SAME is shown.

1. Translate SAME 3 units up and 5 units to the right. Draw and label the new quadrilateral.
2. List the coordinates of both the original and the translated shapes.

**PROMPT**

Ms. L: "Look at this work for a minute and make notes, just thinking to yourself, about what you notice. What would you tell him? I'll give you a minute on your own to start."

Ms. L Pauses for a full minute while students analyze the student work

"Show me a thumbs-up if you're ready to share with a partner, and a thumbs-down if you need more time to think."

Ms. L circulates as students discuss, listening to their conversations and noting any common misconceptions or common approaches among the small groups. She allows 3-4 minutes for partners to discuss before pausing their discussions

I'm hearing such detailed and helpful conversations; great job focusing on the math. On a piece of paper, write down your thoughts for this student. Include the math and any explanation with words or drawings that you think will help this student understand his mistake.

SHARE

Ms. L: [after allowing students 5 minutes to record their thoughts]

"Pause your work for a moment. You are going to join with two other pairs, making groups of six. Each pair will take turns sharing with the others what they would tell my student from third period about his error. Each pair has 2 minutes to explain to the others, and then I'll signal when it is time for the next group to start sharing. How long does each group have to share?"

Whole Class: "2 minutes."

Students get working in their groups. Ms. L circulates, listening to student discussions and noting similarities and differences between student approaches.

REFINE

Ms. L: "I heard so many thoughtful and detailed responses about this error. Let's take a few minutes to gather all our thoughts and decide what makes sense to tell this student about his work. Get back together with your original partner and refine your work to include any of the ideas you heard from others that you think are important. Focus on questions you could ask this student to help his thinking instead of just telling him what to do. You can add to or change what you have. We want to support this student with words, with pictures, with numbers—anything we possibly can to help make sense of the problem. You have 5 minutes to complete your work."

Ms. L circulates as students are working, prompting students to add diagrams, written explanations, or other representations to deepen their explanations.

Integrating Language Routines Into Instruction

Information Gap

Students rely on oral, visual, or written communication to share ideas to bridge gaps in information as they collaboratively solve a problem.

Algebra 1 • Geometry • Algebra 2

Language Routine: Information Gap

The purpose of this routine is for pairs of students to practice interpersonal communication essential to solving a problem.

In this routine, partners work together to solve the problem, justifying their responses using clear and connected language. Partner A has the general problem on a card. Partner B has the information needed to solve the problem on a “data card,” which might contain diagrams, tables, graphs, etc. Partner A needs to make sense of the problem and ask for pieces of information from Partner B. Partner B shares only information that Partner A specifically asks for.

Adapt for groups of four by having two students share the role of Partner A while two other students share the role of Partner B.

Routine	
READ	Partners A and B each read their cards silently and do not show their cards to each another.
THINK-ALoud	Partner A thinks aloud about what information is needed.
QUESTION 1	Partner B asks, “What specific information do you need?” and Partner A answers.
QUESTION 2	Before providing the requested information to Partner A, Partner B prompts Partner A for justification asking, “Why do you need that information?”
EXPLANATIONS	Partner A explains how they are using the information to solve the problem. Partner B helps and asks for justifications even if they understand what Partner A is doing.
FOLLOW-UP	Both students use blank cards to write their own problem and data cards for another pair to use.

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From the Classroom

READ

Mr. Z: "For the next few minutes we are going to work in partners to solve a problem. Find a partner and decide on who is A and who is B. Show me a thumbs up when you're ready!"

All right, I'm going to distribute two different cards. Partners, you cannot show your cards to each other. A's you are the keeper of your information and you will ask B's for details that you need to solve your problem. B's! You are in charge of giving information to your partner only if they ask for it and can provide a reasonable explanation for why they need that information."

Mr. Z distributes the cards to partners and provides 30 seconds for each partner to review their information card.

Card A

MasterTix sold tickets to an upcoming concert. Some were general admission, and others were exclusive access. How many of each type of ticket were sold?

Card B

General admission tickets cost \$12, and exclusive access tickets cost \$18.

The total sales: \$990

Total number of tickets sold: 60

THINK-ALoud

Mr. Z: "A's, now that you know the situation and the problem you are trying to solve, talk through it out loud. Tell your partner the situation."

QUESTIONS AND EXPLANATIONS

Mr. Z: [regains attention of the whole class] "Take a look up here where I've listed out the next several steps for you to follow. B's, you get to ask about specific information that your partner need and make sure they can justify their reasoning. A's, you're in charge of explaining why you need the information and then using what you get to solve the problem."

On-screen prompts:

B's: What specific information do you need? Why do you need it?

A's: Explain what you need and why. Work to solve the problem.

Mr. Z circulates as students are working and supports students in their roles. As needed, Mr. Z asks questions of the different partners to facilitate their thinking like, "What information has your partner asked for? Why do you think they need that?" and "What do you think you need to know to find an answer?"

FOLLOW-UP

Mr. Z: [after groups have solved and verified their work] "Your turn to write a problem card set for another group! Turn over the problem card sets that you have. You get to decide the situation and the values that are important. Put the Problem on Card A and the important information on Card B. In a moment, you'll exchange cards with another partner group to solve a new problem."

Integrating Language Routines Into Instruction

Three Reads

Language is a tool that allows students to not only communicate their math understanding to others, but also to organize their own experience, ideas, and learning for themselves.

Algebra 1 • Geometry • Algebra 2

Language Routine: Three Reads

This routine supports reading comprehension, sense-making, and meta-awareness of mathematical language. It also supports negotiating information in a text with a partner in mathematical conversation. Students are supported in reading a situation/problem three times, each time with a particular focus.

Routine	
FIRST READ	Students read or listen to the problem with the goal of comprehending the text .
SECOND READ	Students read or listen to the situation with the goal of comprehending the mathematics .
THIRD READ	Students read the situation and brainstorm possible mathematical questions pertaining to the context of the problem.

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From the Classroom**FIRST READ**

Mr. A: *Listen carefully for what is going on in this problem.*

Mariana spends half an hour adding water to her pool at a rate of 15 gallons per minute, and then reduces the rate to 9 gallons per minute.

Turn and talk to each other, and tell each other what the problem is about. Each pair needs to have at least one sentence or phrase to share.

Students turn and talk together. Mr. A circulates listens to student discussions.

Mr. A: *Let's start with Yesenia. What did you and your partner discuss?*

Yesenia: *We think this problem is about filling up a pool with water.*

SECOND READ

Mr. A: *All right, this time when I read, listen for important information, like the numbers and the relationship between the numbers.*

Mr. A reads the problem a second time.

Turn and talk with your partner again, thinking about the information you have about the numbers.

Students turn and talk together. Mr. A circulates and listens to student discussions.

Mr. A: *Who can start us off? What numbers are important?*

Sophia: *The rate that the water is running. So the 15 and the 9 are important.*

Mr. A: *Okay, is there anything else that is important to think about?*

Juan: *I think the first half an hour matters. And I want to know how long she spends filling it up at the slower rate.*

THIRD READ

Mr. A: *Juan, you read my mind. We are headed there next. This time when I read the problem, think about what possible questions we could ask.*

[Mr. A reads the problem a third time]

What questions can we ask? Turn and talk with your partner, and be ready to share at least one question in two minutes.

[Students turn and talk together. Mr. A circulates and listens to student discussions]

Mr. A: *I listened while you were talking. Take a look up here, I wrote down what I heard.*

- *How long did she fill the pool at the slower rate?*
- *How much time has to pass for the amount of water filled at the slower rate to equal the amount of water used at the faster rate?*
- *How much water is used for t time?*

Let's think about these different questions and how we can find the answers.

[Mr. A encourages students to draw diagrams, make tables, write equations, and create graphs that represent the quantities and their relationships in the problem, and to use their representations to answer the questions. When students have completed their models, he encourages them to compare and contrast different ways of thinking.]