Table of Contents

How to Use This Addendum

Make sure you're ready to teach by noting the **Necessary Materials and Pre-Lesson Prep** you will need to gather or complete prior to the lesson

Find high-leverage instructional moves in the **Lesson Look Fors**. This is what leaders should see when observing your instruction

Note how your lesson objective ties to your state **Standards**

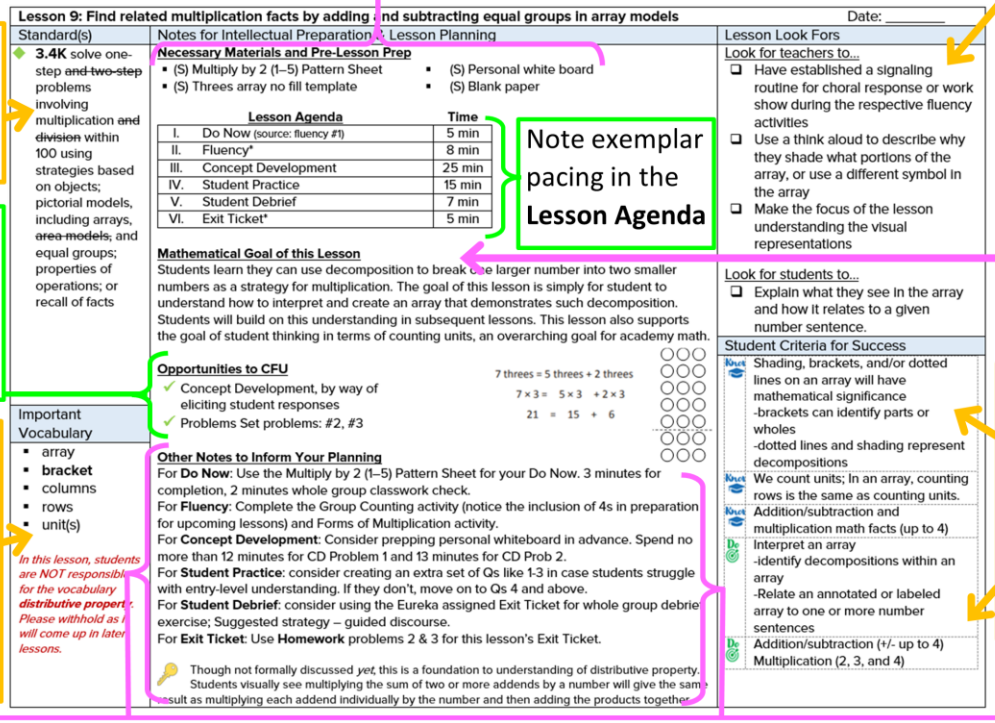
Note exemplar pacing in the **Lesson Agenda**

Use the **Mathematical Goal of the Lesson** to keep you focused on the appropriate student outcome

Plan purposeful questioning and responses using **Opportunities to CFU**

Plan to stress **Important Vocabulary** in the lesson. New vocab for the unit is indicated in bold

Plan instruction around what students need to Know & Do to be successful on the Exit Ticket using the identified **Student Criteria for Success**



Lesson 9: Find related multiplication facts by adding and subtracting equal groups in array models Date: _____

Standard(s)

3.4K solve one-step ~~and two-step~~ problems involving multiplication ~~and division~~ within 100 using strategies based on objects; pictorial models, including arrays, ~~area models,~~ and equal groups; properties of operations; or recall of facts

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep
- (S) Multiply by 2 (1–5) Pattern Sheet
- (S) Threes array no fill template
- (S) Personal white board
- (S) Blank paper

Lesson Agenda		Time
I.	Do Now (source: fluency #1)	5 min
II.	Fluency*	8 min
III.	Concept Development	25 min
IV.	Student Practice	15 min
V.	Student Debrief	7 min
VI.	Exit Ticket*	5 min

Mathematical Goal of this Lesson
Students learn they can use decomposition to break one larger number into two smaller numbers as a strategy for multiplication. The goal of this lesson is simply for student to understand how to interpret and create an array that demonstrates such decomposition. Students will build on this understanding in subsequent lessons. This lesson also supports the goal of student thinking in terms of counting units, an overarching goal for academy math.

Opportunities to CFU
- ✓ Concept Development, by way of eliciting student responses
- ✓ Problems Set problems: #2, #3

7 threes = 5 threes + 2 threes
7 × 3 = 5 × 3 + 2 × 3
21 = 15 + 6

Important Vocabulary
- array
- **bracket**
- columns
- rows
- unit(s)

*In this lesson, students are NOT responsible for the vocabulary **distributive property**. Please withhold as it will come up in later lessons.*

Other Notes to Inform Your Planning
For **Do Now**: Use the Multiply by 2 (1–5) Pattern Sheet for your Do Now. 3 minutes for completion, 2 minutes whole group classwork check.
For **Fluency**: Complete the Group Counting activity (notice the inclusion of 4s in preparation for upcoming lessons) and Forms of Multiplication activity.
For **Concept Development**: Consider prepping personal whiteboard in advance. Spend no more than 12 minutes for CD Problem 1 and 13 minutes for CD Prob 2.
For **Student Practice**: consider creating an extra set of Qs like 1-3 in case students struggle with entry-level understanding. If they don't, move on to Qs 4 and above.
For **Student Debrief**: consider using the Eureka assigned Exit Ticket for whole group debrief exercise; Suggested strategy – guided discourse.
For **Exit Ticket**: Use **Homework** problems 2 & 3 for this lesson's Exit Ticket.

Though not formally discussed *yet*, this is a foundation to understanding of distributive property. Students visually see multiplying the sum of two or more addends by a number will give the same result as multiplying each addend individually by the number and then adding the products together.

Lesson Look Fors

Look for teachers to...
- ❑ Have established a signaling routine for choral response or work show during the respective fluency activities
- ❑ Use a think aloud to describe why they shade what portions of the array, or use a different symbol in the array
- ❑ Make the focus of the lesson understanding the visual representations

Look for students to...
- ❑ Explain what they see in the array and how it relates to a given number sentence.

Student Criteria for Success

Know
- Shading, brackets, and/or dotted lines on an array will have mathematical significance
  -brackets can identify parts or wholes
  -dotted lines and shading represent decompositions
- We count units; In an array, counting rows is the same as counting units.
- Addition/subtraction and multiplication math facts (up to 4)

Do
- Interpret an array
  -identify decompositions within an array
  -Relate an annotated or labeled array to one or more number sentences
- Addition/subtraction (+/- up to 4)
  Multiplication (2, 3, and 4)

Find recommended lesson modifications, content knowledge boosters, and/or high-leverage instructional moves that may not be in your Teacher Edition located in **Other Notes to Inform Your Planning**

UNIT SYNOPSIS

In this unit we study rigid transformations and establish our first definition of congruence, which will be further built upon throughout this course. The opening lesson is an engaging opportunity to get students to experience transformations without needing background knowledge or math vocabulary. The terms “reflection,” “rotation,” and “translation” are more meaningful after students have gotten to participate in this opening activity.

After the opening lesson, each type of rigid transformation (translation, reflection, and rotation) gets its own lesson in which students deepen their understanding of each transformation and how to describe it verbally and on the page. Students then work with compositions of transformations and think about whether the order in which transformations are performed matters or not.

Last, students begin exploring congruence. They figure out that two figures are congruent if one can be mapped onto the other after undergoing a series of transformations.

CONTENT STANDARDS

Below are the standards addressed in this unit.

Readiness Standards	Supporting Standards
G.3(B) determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~	**G.3(A)** describe and perform transformations of figures in a plane using coordinate notation **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane **G.6(C)** apply the definition of congruence, in terms of rigid transformations, to identify congruent figures and their corresponding sides and angles

Focus on Disciplinary Literacy 	Mathematical Process Standard (F) – analyze mathematical relationships to connect and communicate mathematical ideas
	Mathematical Process Standard (G) – display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication

LEARNING SUPPORTS BY LESSON

There is a checkmark for the math support if the lesson...	Lessons → Math Supports	L1	L2	L3	L4	L5	L6	L7	L8
makes a connection to prior content or from a previous unit or academic year	Access Prior Knowledge		✓	✓	✓	✓	✓	✓	✓
uses familiar contexts or experiences to make the learning relevant to students	Real-World Connections	✓							
makes use of graphic organizers	Graphic Organizers								
includes tools like rulers, protractors, patty paper, algebra tiles, etc.	Tools or Manipulatives				✓				
incorporates tables, reference charts, displays, pictures, models, or color-coding	Visual Aids	✓	✓	✓	✓	✓	✓	✓	✓
includes definitions, examples vs. nonexamples, cognates, etc.	Vocabulary Supports	✓	✓	✓	✓	✓	✓	✓	
includes strategies that support language development	Language Supports	✓	✓	✓	✓	✓	✓	✓	✓
asks students to discuss with their partner to prepare for whole class discussion	- Turn and Talk	✓	✓	✓	✓	✓	✓	✓	
teacher facilitates a whole class discussion to debrief key learnings	- Guided Discussion	✓	✓	✓	✓	✓	✓	✓	
asks students to think independently, test their idea with a partner, and share whole group	- Think, Pair, Share	✓	✓	✓	✓			✓	
includes sentence stems to support students with explanations	- Sentence Stems		✓						
provides opportunities for students to work with a partner or a group	Peer Collaboration	✓	✓	✓	✓	✓	✓	✓	✓
uses mnemonics such as Soh-Cah-Toa	Mnemonics								
includes websites or equipment that enhances the lesson	Technological Support								
content can be presented in different forms	Different Modalities								
uses hands-on tools or manipulatives to represent the math	- Concrete				✓				
uses drawings to represent the math	- Pictorial	✓	✓	✓	✓	✓	✓	✓	✓
uses numbers and number sentences to represent the math	- Abstract	✓	✓	✓	✓	✓	✓	✓	✓

The EFFL Model

Experience First, Formalize Later (EFFL) Model

Opening

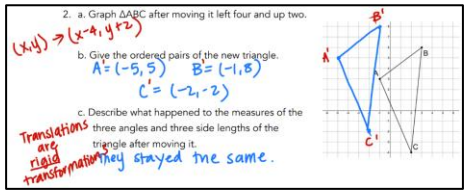
For every new lesson, the teacher begins by making the goals of the lesson crystal clear. The teacher does more than simply read the objective to the class. They make connections to previous learning, share how this learning fits into a bigger picture, or explain why this learning is important for future learning.

Activity / Interaction With New Material (INM)

For this part of the lesson, students work in pairs or groups of four to experience new content through an activity. Students might be discussing a proposed scenario, working with other groups, or doing a simulation. The student activity is designed for students to be able to do without the help of the teacher. Of course, the teacher is watching and listening in to conversations in order to formatively assess student understanding. The teacher provides questions, cues, and prompts (not answers!) to help push groups forward when they are stuck or have made a mistake. As students begin to finish the activity, the teacher identifies students to write their work on the board. Most often, the teacher selects student work that will easily allow them to connect the experience to formal learning. Students write their work on the whiteboard in a single-color marker.

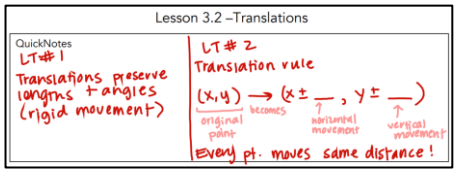
Debrief Activity

Once students have recorded their responses in their workbook (see blue writing to the right), the teacher calls the whole group back together for a debrief. It is in this discussion that the teacher will help students formalize the learning. The teacher connects the student activity experience to new vocabulary, definitions, formulas, and algorithms. The formal learning is attached specifically to the experiences of the activity so that students can enhance their constructed understanding of the new content. The teacher writes all of the formal learning in a different color in the margins of the activity **(see red writing to the right).** The students add these ideas in the margins on their activity page and often think of this as the formal "notes" of the lesson. In all of the answer keys we provide on Math Medic, the teacher formal learning points are provided in the margins in a **different color.**



QuickNotes

In this part of the lesson, the teacher uses the whole experience of the activity and the formalization in the debrief to summarize the learning from the lesson. Notice that we use the box to constrain the amount of formal "notes" that the teacher can provide.



Student Practice

Now that students have arrived at some new learning, they need to be able to apply it in new contexts. Most often we have students complete these questions in pairs and occasionally we select one question to use as an exit ticket. If we have time, we have students write solutions on the whiteboard.

Extra Practice

We typically give students around 3-5 "Extra Practice" problems for each lesson. We choose problems that are closely aligned with the Learning Objectives of the lesson. It is our belief that "less is more" here. We would rather students spend their Extra Practice time thinking deeply about just a few problems, rather than surface level thinking on many problems. When possible, we provide the answers at the bottom of the page, so they can immediately assess their understanding.

Slightly modified version of: https://www.calc-medic.com/post/experience-first-formalize-later#:~:text=%E2%80%9CExperience%20First%2C%20Formalize%20Later%E2%80%9D,at%20formal%20definitions%20and%20formulas.

Before You EFFL!

Here are helpful resources that you guide you in the right direction before your first EFFL lesson!

Why Should We EFFL?

The article advocates for the Experience First, Formalize Later (EFFL) teaching model, emphasizing its effectiveness in fostering deep understanding and flexible thinking in students. The author compares traditional teaching to a game of "Simon Says," where students merely mimic instructions without grasping underlying concepts. In contrast, EFFL encourages students to engage actively with problems, enhancing their ability to understand and apply calculus concepts creatively.

Tips for Lesson Planning

The article offers practical advice for effective lesson planning beyond the exhaustive and overly detailed approaches often emphasized during teacher training. It underscores the importance of thoughtful preparation but rejects the notion that teachers need to script every minute or detail of a class session.

Making the Most of Your EFFL Lesson Debrief

The article discusses the significance of the debriefing phase in the Experience First, Formalize Later (EFFL) lesson model, emphasizing its role in reinforcing learning and highlighting student contributions. The debrief session is seen as crucial for integrating academic vocabulary, emphasizing key lesson understandings, and valuing students' mathematical insights.

While You EFFL!

While each lesson may be unique in context and skills, all lessons benefit from the following practices:

Teacher Look Fors:

- ❑ Utilizing the Do Now to spark students' interest in the Activity.
- ❑ Use questioning to promote small group discussion and exploration, guided by monitoring questions.
- ❑ Connects Experience First to formal concepts using a colored pencil/pen to take notes along the margin during the Debrief.
- ❑ Facilitates whole-class discussions for students to reflect, share insights, and provides feedback that reinforces key concepts.
- ❑ Tracks time to adapt lesson pacing and support based on student response and engagement.

Students Look Fors:

- ❑ In the Activity, students engage in group work and discourse.
- ❑ Exploring the activity, testing hypotheses and approaches (trial & error).
- ❑ Take notes on key ideas and concepts using different colored pencil/pen to take notes along the margin.
- ❑ Share thoughts and ideas that demonstrate their approach to their work.

Other considerations

- During the **Experience First** phase, if most of your students seem stuck or disengaged, take a moment to pause, reset, and provide clear instructions. Some problems of the Activity are more suitable to do a whole-class discussion as a means to save some instructional time for Student Practice or the Exit Ticket. You are encouraged to adapt the EFFL (Experience First, Formalize Later) process to meet your students' needs while maintaining a focus on student-centered instruction.

ROADMAP

AT A GLANCE: Unit 3 – Congruence Transformations			
Day	Date	Lesson	Lesson Title
There are 4 flexible Success Days that you can use anywhere in the unit. • Consider using 1 day between Lessons 4 and 5 to administer an optional topic quiz (and another after lesson 7). • Consider using 1 day to review before the Unit 3 Exam. • If you don't need to use all 3 success days, you can/should save them for later.			
1		1	Introduction to Transformations
2		2	Translations
3		3	Reflections
4		4	Rotations
5			Success Day (Ideal time to administer **optional** Unit 3 Topic Quiz A)
6		5	Composition of Transformations (Day 1)
7		6	Composition of Transformations (Day 2)
8		7	Definition of Congruence
9			Success Day (Ideal time to administer **optional** Unit 3 Topic Quiz B)
10		CR	Cumulative Review | Success Day
11			Unit 3 Exam
12			Success Day

Lesson 1: Introduction to Transformations | Date: _____

Standard(s)

- **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~

Important Vocabulary

- **image**
- **preimage**
- **prime notation**
- **reflection**
- **rotation**
- **translation**
- **transformation**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 3 Student Edition
- Copies of extra grids
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (20 min)
- Debrief (5 min)
- Student Practice (13 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to distinguish between translations, reflections, and rotations. They should also be able to visualize the sequence of "moves" required to take a preimage to its image. In the next four lessons, students will dive more deeply into each type of rigid transformation.

Opportunities to CFU

- ✓ INM: 2, 3, 4
- ✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

For the **Do Now:** Note that you will go over the Do Now during the beginning of the INM, as the INM connects to the Do Now. The Do Now cannot be skipped.

For the **INM**: Do not worry about establishing vocabulary terms yet. During the INM, students are "experiencing" these transformations (and compositions of transformations!). They'll get to "formalize" these transformations during the Debrief.

Focus on Disciplinary Literacy

INM #2

For the **Exit Ticket**: Know that there is more than one correct answer. If time allows, consider having students trade and grade with a partner, many of whom will be able to tell you if their partner's sequence is possible or not.

Lesson Look Fors

Look for teachers to...

- ❑ encourage students to find multiple sequences in INM#2, and stamp that there are a lot!
- ❑ challenge students to find the most efficient sequence in INM#3
- ❑ avoid introducing vocabulary during the INM; save it for debrief

Look for students to...

- ❑ challenge themselves to find multiple sequences (as opposed to finding one and stopping).
- ❑ collaborate with their partner or team throughout the INM.

Student Know/Do Chart

Do	Students can describe a sequence of moves that map a preimage to its image.
Know	A translation is a shift that can be up, down, left, and/or right.
Know	A rotation is when a preimage turns by degrees.
Know	A reflection is a "flip" over a line (e.g. $y = x$, $y = 2$, x –axis, etc.)

Lesson 2: Translations Date: _____

Standard(s)

- **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~
- **G.3(A)** describe and perform transformations of figures in a plane using coordinate notation
- **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane

Important Vocabulary

- **rigid transformation**
- translation
- **translation rule**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 3 Student Edition
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (10 min)
- Debrief (10 min)
- Student Practice (18 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to write a translation rule and give the ordered pairs of an image after a translation.

Opportunities to CFU

✓ INM: 2

✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

For **Do Now:** This Do Now sets up the rest of the lesson and cannot be skipped or replaced.

For **INM**: INM#2 should be a turn and talk. While students are working together, be sure to circulate and listen in on conversations so you'll know which ones to lift for the class when you bring the class back together.

Focus on Disciplinary Literacy

INM #2

Lesson Look Fors

Look for teachers to…

- ❑ stamp that translations preserve lengths and angle measures (during Debrief).
- ❑ Emphasize the use of prime notation to distinguish images from preimages (during Debrief)

Look for students to…

- ❑ work with their partner or team to reason through the INM with minimal teacher intervention.

Student Know/Do Chart

Do — Students can write a translation rule given an image and its preimage.

Know — A translation is a movement of every point in a figure the same distance in the same direction.

Know — A translation rule is a way to communicate how each of a preimage's points is shifted to form the image. It is in the form $(x, y) \rightarrow (x+?, y+?)$.

Lesson 3: Reflections Date: _____

Standard(s)

- **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~
- **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane

Important Vocabulary

- **equidistant**
- Image
- **line of reflection**
- pre-image
- reflection
- rigid transformation

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 3 Student Edition
- Patty paper (1 sheet per student)
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (20 min)
- Debrief (5 min)
- Student Practice (13 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to identify patterns in ordered pairs when a figure is reflected across the x-axis, y-axis, or the line $y = x$. They should come to the realization that a point and its image after a reflection are equidistant from the line of reflection.

Opportunities to CFU

✓ INM: 2c, 3c, 4b

✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

For **Do Now:** You may formally debrief the Do Now before moving onto the INM. If you do not, you should definitely do so before releasing students to complete INM #4.

Focus on Disciplinary Literacy

INM #s 5-6

For **Debriefs**: Note that there are two separate debriefs (and two rounds of INM). Debrief #s 1-3 after students have worked on them. Then, debrief remaining questions after INM.

Lesson Look Fors

Look for teachers to…

- ❑ have two debrief sessions. The first should occur over #s 1-3 BEFORE students work on #4. The second should occur over #s 4-6 at the end of the INM.
- ❑ circulate and actively monitor as students work together. If necessary, provide as minimal support as possible to keep students going.

Look for students to…

- ❑ notice the patterns that emerge when figures are reflected across a line.

Student Know/Do Chart

Students can reflect a figure over the y-axis.

Students can determine if coordinates given for an image after a reflection are accurate.

A point and its image after a reflection should be equidistant from the line of reflection.

A point from an image after a reflection should NOT be on the same side as its corresponding point on the pre-image. If that's the case, a reflection hasn't truly happened.

Lesson 4: Rotations Date: _____

Standard(s)

- **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~
- **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane

Important Vocabulary

- **clockwise**
- **counter-clockwise**
- rotation

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 3 Student Workbook
- colored pencils (2 diff. colors per student)
- Class set of red pens
- Patty paper (2 per student)

Lesson Structure:

- Do Now (7 min)
- INM (18 min)
- Debrief (5 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to perform and describe rotations in the coordinate plane with the origin as the center. They should also be able to identify patterns in ordered pairs when a figure is rotated 90°, 180°, or 270° degrees.

Opportunities to CFU

✓ INM: 4, 5b, 6b

✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

For **Do Now:** This Do Now sets up the INM and cannot be skipped. Students will need the patty paper, so plan ahead to ensure students have access to it before the Do Now begins (or at least at the beginning of the Do Now).

For **Debrief:** When debriefing, it is worth showing once more how a y-value of 5 becomes an x-value of -5. Students should see how the y-axis when rotated lands on the x-axis. When writing the ordered pair rules, ask students why these rules make sense. Have them explain to their partner, why each rule corresponds to the given rotation. The signs of each coordinate make more sense when considering how the ordered pair moves to the next quadrant when rotating by 90˚. Students should also see that a 180˚ rotation and a 270˚rotation are simply two and three 90˚ rotations back to back, respectively, so really only one "rule" is necessary.

For **Exit Ticket**: Allow students to use patty paper to make the rotation. Some might have memorized the rule $(x, y) \rightarrow (-y, x)$, but if students have patty paper, they can perform the transformation without memorizing any rules.

Focus on Disciplinary Literacy

Debrief

Lesson Look Fors

Look for teachers to…

- ❑ before releasing students to work together for the INM, model how to use patty paper. Some students may have never used it before!
- ❑ on the patty paper, ensure students color each axis a different color. This will help them see why x and y 'switch' with each 90° rotation.

Look for students to…

- ❑ "stick together" with their team. Team members should verify their own rotations by checking their ordered pairs with others in the group. Students should not work ahead of their team.
- ❑ Identify patterns that emerge in the table near INM#1. These patterns reveal the relationship between a preimage and its rotated image.

Student Know/Do Chart

Students can rotate a figure 90° counterclockwise about the origin on the coordinate plane.

A 90 degree rotation about the origin is ¼ of the way around the origin.

Counterclockwise is "backwards" on an analog clock (e.g. going from 12, to 11, to 10, etc.).

When a preimage with points at (x, y) is rotated clockwise 90 degrees, the image of each corresponding point will be $(-y, x)$.

You can use patty paper to help you plot the image of a rotated figure.

Lesson 5: Composition of Transformations (Day 1 of 2) Date: _____

Standard(s)

- **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~
- **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane.

Important Vocabulary

- **composition of transformations**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 3 Student Edition
- Challenge Cards (one set per team)
- Class set of colored pencils
- Class set of red pens
- Patty paper (~5 sheets per group) and graph paper

Lesson Structure:

- Do Now (7 min)
- INM (20 min)
- Debrief (5 min)
- Student Practice (23 min)
- Exit Ticket (0 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to perform two or more transformations in sequence on the coordinate plane. They should also be able to determine the sequence of transformations that takes a preimage to its image and explore the outcomes of changing the sequence in which transformations are performed. This is the first day of a two day lesson. **Only one exit ticket is provided for both days, and it should be given at the end of the second day (not today).**

Opportunities to CFU

✓ INM: Challenge #1

✓ Student Practice: 1, 2, & 3

Other Notes to Inform Your Planning

For **Do Now:** The Do Now is a brief review of individual transformations. While it is good for activating prior knowledge, it is okay to replace it OR to prioritize 1-2 questions. Some students may struggle to answer all 3 in just 5-7 minutes.

For **INM**: This INM involves a lot of trial and error for most students. For Challenge #1, encourage students to keep track of what order they tried so that they don't get frustrated and accidentally repeat the same order. For #2, provide students with graph paper so they can try out their ideas and visually prove their response.

Focus on Disciplinary Literacy

Debrief #1

Lesson Look Fors

Look for teachers to…

- ❑ explain that this is the start of a two day lesson and that the goal is to try Challenges 1 and 2 today.
- ❑ debrief after each challenge.
- ❑ explain that problem solving is "what we do when we don't know what to do," and that there might be times when today's challenge feels insurmountable

Look for students to…

- ❑ try any sequence from the transformations provided in Challenge #1. If it doesn't work, try a different sequence.
- ❑ in Challenge #2, experiment with a variety of transformation cards to see if they can determine when order matters AND when it doesn't matter.

Student Know/Do Chart

Do — Students can determine whether the order in which two transformations are performed matters or not.

Do — Students can visually justify their response to a question about composition of transformations using a coordinate plane and an example point of their choosing.

Know — Depending on the transformations described, sometimes the order in which the transformations are executed matters. Sometimes it does not.

Lesson 6: Composition of Transformations (Day 2 of 2) Date: _____

Standard(s)

- **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~
- **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane.

Important Vocabulary

- composition of transformations

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 3 Student Edition
- Challenge Cards (one set per team)
- Class set of red pens
- Patty paper (~5 sheets per group)

Lesson Structure:

- Do Now (7 min)
- INM (18 min)
- Debrief (5 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to perform two or more transformations in sequence on the coordinate plane. They should also be able to determine the sequence of transformations that takes a preimage to its image and explore the outcomes of changing the sequence in which transformations are performed. This is the **SECOND** day of a two day lesson. An exit ticket may be administered at the end of this class period.

Opportunities to CFU

✓ INM: Challenge #3

✓ Student Practice: 1, 3

Other Notes to Inform Your Planning

For **Do Now:** This Do Now can be skipped or replaced if you wish to spiral in a high priority concept from a previous unit. However, this Do Now serves to activate prior knowledge and may help students that struggled with Day 1.

For **INM:** Prioritize Challenge #3. It is okay if you do not get to #s 4 and 5. It is important to preserve the "Composition of Transformation" QuickNotes and traditional Student Practice problem set instead.

Focus on Disciplinary Literacy

Debrief

Lesson Look Fors

Look for teachers to…

- ❑ set up the day by reminding students that things will get challenging, but that they should persevere anyway and try to figure it out.
- ❑ prioritize and clearly state which challenge students should complete first
- ❑ debrief after each challenge
- ❑ actively circulate and monitor to find appropriate times to debrief.

Look for students to…

- ❑ in Challenge #3, experiment with a variety of transformation cards.

Student Know/Do Chart

Students can perform a composition of transformations and identify the image's final coordinates.

A point and its image after a reflection should be equidistant from the line of reflection.

A translation rule is a way to communicate how each of a preimage's points is shifted to form the image. It is in the form $(x, y) \rightarrow (x+?, y+?)$.

Lesson 7: Definition of Congruence Date: _____

Standard(s)

- **G.6(C)** apply the definition of congruence, in terms of rigid transformations, to identify congruent figures and their corresponding sides and angles

Important Vocabulary

- **congruent**
- **congruence statements**
- **isometry**
- rigid transformation

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 3 Student Edition
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (15 min)
- Debrief (8 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to determine if two figures are congruent, identify corresponding sides and angles in congruent figures, and write congruence statements. Students should understand that if one figure can be transformed so that it is on top of another figure, then those two figures are congruent. On the flipside, if two figures are congruent, there must be a series of transformations that can superimpose one onto the other.

Opportunities to CFU

- ✓ INM: 2, 3
- ✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

Focus on Disciplinary Literacy

INM #2

For **Do Now:** This Do Now should not be skipped or replaced; it sets up the INM.

For **Debrief:** When discussing congruence statements, be sure to point out that the order in which vertices are written matters! When debriefing INM #2, let students know that we'll be learning about non-rigid transformations (like what we see in 2b) in a future unit.

About the **Exit Tickets**: Two exit tickets are provided, but you will probably only have time to administer one of them. Exit Ticket (A) focuses on writing and interpreting congruence statements. Exit Ticket (B) focuses on using transformations to prove two figures are congruent. Both are key ideas of Lesson 7, so you can give one today and save another for a Success Day.

Lesson Look Fors

Look for teachers to...

- ❑ in INM#2, stamp the difference between rigid (2a) and nonrigid (2b). In later units we will learn more about dilations.
- ❑ during debrief, stamp meanings of "congruent" and "isometry."
- ❑ when writing congruence statements, emphasize that the order of vertices matters; theirs orders must correspond.

Look for students to...

- ❑ reason through INM #s 2 and 3 with their partners.
- ❑ build upon their prior knowledge of congruence, something they have been exploring on-and-off since elementary.

Student Know/Do Chart

- Do: Students can determine if two figures are congruent or not and explain why.
- Do: Students can accurately write a congruence statement (letters in corresponding order).
- Do: Given that two figures are congruent, students can determine missing side lengths and/or angle measures.
- Know: Two figures are congruent if one can be moved by a series of transformations so that it fits exactly on top of the other.
- Know: If one figure cannot be superimposed upon another through a series of rigid transformations, then these two figures are NOT congruent. No congruence statement can be written.

Recommended Unit 3 Success Day Material and Resources

Date: _____

To review or practice transformations in general, try...

- Carnegie: Transformations Skills Practice
- this resource from the Progressive Mathematics Initiative. Before using this resource, carefully go through it and select the questions most applicable to what you want to review. Not every question will be applicable.
- Big Ideas in Mathematics: Transformations SW | TE

If you need to review or reteach Lesson 1 (Introduction to Transformations), try

- Kahoot: Introduction to Transformations
- IM: Compose Transformations SW | TE

If you need to review or reteach Lesson 2 (Translations), try

- Kahoot: Examining and Using Translations
- Kahoot: Translations of Polygons
- 22-23 MCR Lesson 7.2 (Translations) SE | TE
- IM: Identify and Describe Translations SW | TE

If you need to review or reteach Lesson 3 (Reflections), try

- Kahoot: Examining and Using Reflections
- 22-23 MCR Lesson 7.1 (Reflections) SE | TE
- IM: Write Rules for Translations and Reflections SW | TE

If you need to review or reteach Lesson 4 (Rotations), try

- Kahoot: Examining and Using Rotations
- Kahoot: Rotations of Polygons (Part 1)
- Kahoot: Rotations of Polygons (Part 2)
- 22-23 MCR Lesson 7.3 (Rotations) SE | TE
- IM: Rotate Figures on a Coordinate Plane SW | TE

If you need to review or reteach Lessons 5/6 (Composition of Transformations), try

- Kahoot: Compositions of Transformations of Polygons (Part 1)
- Kahoot: Compositions of Transformations of Polygons (Part 2)
- 22-23 MCR Lesson 7.6 (Composition of Transformations Day 1) SE | TE
- 22-23 MCR Lesson 7.7 (Composition of Transformations Day 2) SE | TE

If you need to review or reteach Lesson 7 (Congruence), try

- Kahoot: Using the definition of Triangle Congruence in Terms of Rigid Motions
- Khan Academy: Find Measures Using Rigid Transformations
- Big Ideas in Math: Congruent Figures SW | TE

Cumulative Review | Success Day Date: _____

Standard(s)	Notes for Intellectual Preparation & Lesson Planning	Lesson Look Fors
◆ **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~ ◆ **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane ◆ **G.6(C)** apply the definition of congruence, in terms of rigid transformations, to identify congruent figures and their corresponding sides and angles	**Necessary Materials and Pre-Lesson Prep** ▪ Review students' Unit 3 exit ticket data to determine what to prioritize during review ▪ Internalize Review Lesson 3.8 if you choose to use it and print and cut its task cards. Lesson Structure: Do Now (7 min) INM (38 min) Debrief (10 min) Student Practice (0 min) Exit Ticket (0 min)  **Mathematical Goal of this Lesson** By the end of this class period, students should get the opportunity to review major concepts from Unit 3. **Other Notes to Inform Your Planning** You should use this Success Day to review however you see fit. An optional review activity has been provided in the Teacher Edition called "Around the World" (Review Lesson 3.8). It is a group task in which students will travel "around the world" to complete as many problems as they can. (See the Lesson 3.8 TE for more detailed directions and resources.)	Look for teachers to… ❑ facilitate a review session that prioritizes what students need based on previous exit ticket and/or quiz data. Look for students to… ❑ review Unit 3 topics in preparation for the Unit 3 exam.

Student Know/Do Chart
Students can prepare for the Unit 3 Exam by reviewing Unit 3 content.

Unit 3 Exam	Date: _____
Standard(s)	Notes for Intellectual Preparation & Lesson Planning
◆ **G.3(B)** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~ ◆ **G.3(C)** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane ◆ **G.6(C)** apply the definition of congruence, in terms of rigid transformations, to identify congruent figures and their corresponding sides and angles	**Necessary Materials and Pre-Lesson Prep** ▪ Ensure you can access UE3 on EdCite. **Notes to Inform Your Planning** Review the Unit 3 Exam on Curriculum Corner. Internalize and create an exemplar for the assessment prior to teaching the unit as part of unpacking the unit. Use your exemplar to spar with the solutions provided in the Assessment Companion on Curriculum Corner. The scanning deadline for the Unit 3 Exam is **October 16, 2025**. Consider administering the exam 1-3 school days BEFORE October 16th to allow sufficient time for grading the FRQ. Refer to the scoring guide to score the FRQ.

UNPACKED STANDARDS

Focus standards for this unit.

Standards Clarification		
Standards	**Specificity**	**Notes/Explanations/Examples**
G.3B determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, ~~a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane~~	<u>Content:</u> • image • pre-image • composition of transformations • rigid transformations • transformation notation <u>Including but not limited to:</u> • single transformations • identifying and describing what transformation or composition of transformations has occurred	**2.** What is the image of $X(3, 5)$ along the translation vector $\langle -4, 6 \rangle$? **A.** $X'(7, -1)$ **B.** $X'(-1, -1)$ **C.** $X'(7, 11)$ **D.** $X'(-1, 11)$

VERTICAL STANDARDS

This section details the **progression** of key student expectations/standards** in the courses **before** and **after** this course. This will help you understand what **prior knowledge skills to build upon** and guide you in knowing what **skills you are preparing your students** for in the subsequent course.

7th Grade	Geometry	Algebra II
7.5A generalize the critical attributes of similarity, including ratios within and between similar shapes. **7.5C** solve mathematical and real-world problems involving similar shape and scale drawings.	**G.3B** determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane. **G.3C** identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane. **G.6C** apply the definition of congruence, in terms of rigid transformations, to identify congruent figures and their corresponding sides and angles.	**2A.4C** determine the effect on the graph of f(x) = √x when f(x) is replaced by af(x), f(x) + d, f(bx), and f(x - c) for specific positive and negative values of a, b, c, and d. **2A.5A** determine the effects on the key attributes on the graphs of f(x) = b x and f(x) = logb (x) where b is 2, 10, and e when f(x) is replaced by af(x), f(x) + d, and f(x – c) for specific positive and negative real values of a, c, and d. **2A.6A** analyze the effect on the graphs of f(x) = x 3 and f(x) = 3 √x when f(x) is replaced by af(x), f(bx), f(x - c), and f(x) + d for specific positive and negative real values of a, b, c, and d. **2A.6C** analyze the effect on the graphs of f(x) = |x| when f(x) is replaced by af(x), f(bx), f(x- c), and f(x) + d for specific positive and negative real values of a, b, c, and d. **2A.6G** analyze the effect on the graphs of f(x) = 1/x when f(x) is replaced by af(x), f(bx), f(x- c), and f(x) + d for specific positive & negative real values of a, b, c, & d.
Algebra I		**Pre-Calculus**
A.3E determine the effects on the graph of the parent function f(x) = x when f(x) is replaced by af(x), f(x) + d, f(x - c), f(bx) for specific values of a, b, c, and d. **A.7C** determine the effects on the graph of the parent function f(x) = x^2 when f(x) is replaced by af(x), f(x) + d, f(x - c), f(bx) for specific values of a, b, c, and d.		**P.2D** describe symmetry of graphs of even and odd functions. **P.2I** determine and analyze the key features of exponential, logarithmic, rational, polynomial, power, trigonometric, inverse trigonometric, and piecewise defined functions, including step functions such as domain, range, symmetry, relative maximum, relative minimum, zeros, asymptotes, and intervals over which the function is increasing or decreasing.