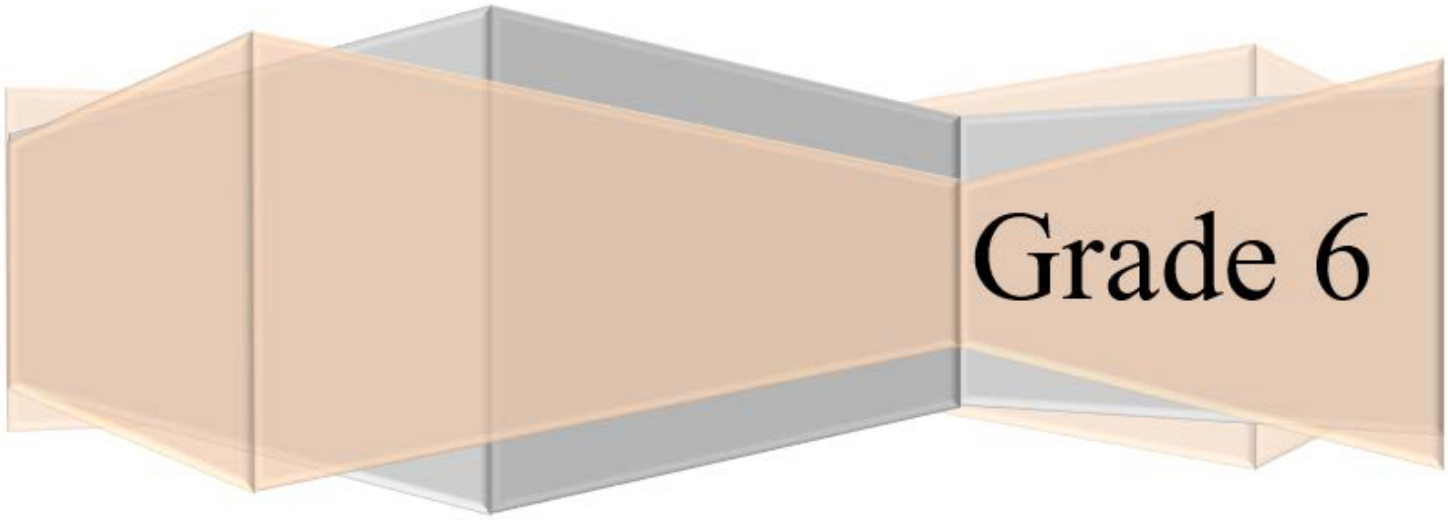
Scaffolding Instruction for All Students:

A Resource Guide for Mathematics



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Scaffolding Instruction for All Students: A Resource Guide for Mathematics Grade 6

Acknowledgements

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Introduction

The Next Generation English Language Arts (ELA) and Mathematics Learning Standards intend to foster the 21st century skills needed for college and career readiness and to prepare students to become lifelong learners and thinkers. Learning standards provide the "destination" or expectation of what students should know and be able to do while teachers provide the "map" for getting there through high-quality instruction. **Lessons need to be designed to ensure accessibility to a general education curriculum designed around rigorous learning standards for all students, including students who learn differently (e.g., students with disabilities, English Language Learners (ELLs)/Multilingual Learners(MLLs), and other students who are struggling with the content).** It is vital that teachers utilize a variety of research-based instructional and learning strategies while structuring a student-centered learning environment that addresses individual learning styles, interests, and abilities present among the students in the class. Classrooms should be supportive and nurturing, and factors such as the age, academic development, English and home language proficiency, culture and background knowledge, and disability, should be considered when designing instruction. The principles of Universal Design for Learning should be incorporated into curricula to provide students with learning experiences that allow for multiple means of representation, multiple means of expression, and multiple means of engagement. These learning experiences will reduce learning barriers and foster equal learning opportunities for all students.

The purpose of these guides is to provide teachers with examples of scaffolds and strategies to supplement their instruction of ELA and mathematics curricula. Scaffolds are instructional supports teachers intentionally build into their lesson planning to provide students support that is "just right" and "just in time." Scaffolds do not differentiate lessons in such a way that students are working on or with different ELA texts or mathematical problems. Instead, scaffolds are put in place to allow all students access to grade-level content within a lesson. Scaffolds allow students to develop the knowledge, skills, and language needed to support their own performance in the future and are intended to be gradually removed as students independently master skills.

The scaffolds contained in these guides are grounded in the elements of explicit instruction as outlined by Archer and Hughes (2011). Explicit instruction is a structured, systematic approach to teaching which guides students through the learning process and toward independent mastery through the inclusion of clear statements regarding the purpose and rationale for learning the new skill/content; explanations and demonstrations of the instructional target; and supported practice with embedded, specific feedback.

The scaffolds in these guides can be adapted for use in any curricula and across content areas. While the exemplars were all drawn from the ELA and mathematics EngageNY modules, teachers are encouraged to customize the scaffolds in any lesson they deem appropriate. **All teachers (e.g., general, special education, English as a New Language, and Bilingual Education teachers) can use these scaffolds in any classroom setting to support student learning and to make the general education curriculum more accessible to all students without interfering with the rigor of the grade-level content.**

How to Use These Guides

The provision of scaffolds should be thoughtfully planned as to not isolate or identify any student or group of students as being "different" or requiring additional support. Therefore, in the spirit of inclusive and culturally responsive classrooms, the following is suggested:

- Make scaffolded worksheets or activities available to all students.
- Heterogeneously group students for group activities when appropriate.
- Provide ELLs/MLLs with opportunities to utilize their home language knowledge and skills in the context of the learning environment.
- Make individualized supports or adapted materials available without emphasizing the difference.
- Consistently and thoughtfully use technology to make materials more accessible to all students.

In the ELA guides, the *Table of Contents* is organized to allow teachers to access strategies based on the instructional focus (reading, writing, speaking and listening, and language) and includes a list of scaffolds that can be used to address those needs. In the mathematics guides, the *Table of Contents* is organized around the scaffolds themselves.

Each scaffold includes a description of what the scaffold is, who may benefit, and how it can be implemented in a lesson-specific model (see graphic below). Teachers are encouraged to make changes to presentation and language to best support the learning needs of their students. While lessons from the EngageNY modules are used to illustrate how each scaffold can be applied, **the main purpose of the exemplars is to show how teachers can incorporate these scaffolds into their lessons as appropriate.**

Title of Scaffold
Module: Unit: Lesson:
Explanation of scaffold: This section provides a deeper explanation of the scaffold itself including what it is and how it can and should be used. This section is helpful when implementing the scaffold in other lessons.
Teacher actions/instructions: This section provides specific instructions for the teacher regarding successful implementation of the scaffold.
Student actions: This section describes what the students are doing during the scaffolded portion of the lesson.
Student handouts/materials: This section indicates any student-facing materials that must be created to successfully use this scaffold.

Warm-up Review

Exemplar from:

Module 1: Topic A: Lesson 3: Equivalent Ratios

Explanation of scaffold:

This scaffold provides students with the opportunity to review previously learned skills and concepts that are needed to build a strong foundation for new lesson material. Establishing a warm-up review routine at the beginning of class allows students to connect with prior knowledge and allows teachers to quickly assess student understanding of key concepts, build automaticity and fluency of important skills and concepts, and give targeted corrective feedback.

Teacher actions/instructions:

A warm-up review can be used at the beginning of class to engage students and activate prior knowledge, before introducing a new lesson, when reteaching skills and concepts to small groups of students, and as homework for struggling students. The procedures of the routine for completion of a warm-up review should be explicitly taught to students at the beginning of the school year.

The following is a model of how a type of warm-up review could be used to focus on the prerequisite skills needed for this lesson:

1. Display a large version of the *Warm-up Review* sheet on chart paper or use a document camera to project your work. Hand out student copies.
2. Give students five minutes to complete the warm-up.
   - Walk about the classroom and monitor student work.
   - Give corrective feedback to individual students as needed.
   - Give struggling students the option to work with a partner.
   - Remind students of information addressed during prior lessons:
     - A ratio is an ordered pair of non-negative numbers, which are not both zero, that is often used as a way of describing the first number as a multiple of the second. The ratio is denoted A: B or A to B to indicate the order of the numbers. The number A is first, and the number B is second. The order of the numbers is important!
3. Review answers as a class.
   - Have students explain steps;
   - Review steps, but involve students by eliciting unison responses; or
   - Have students use thumbs up/thumbs down to indicate agreement/disagreement with answers. Have them explain why.

Answers to Problem 1:

a. 3:7, 3 to 7, or $\frac{3}{7}$

b. For every 3 red squares, there are 7 blue circles.

Answers to Problem 2:

- 4:3 = 7 total students
- 12:9 = 21 total students
- 16:12 = 28 total students

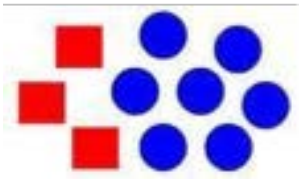
Student actions:
Students complete the *Warm-up Review* sheet and participate in the warm-up review routine as directed.

Student handouts/materials:
Warm-up Review sheet (found on the next page)

Warm-up Review
Module 1, Topic A, Lesson 3: Equivalent Ratios

Name _____ **Date** _____

1. a. Use numbers to write the ratio of red squares to blue circles illustrated below.



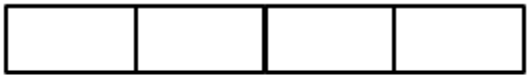
_____

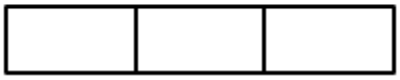
b. Use words to describe the ratio relationship.

_____

2. The ratio of the number of girls to the number of boys in a classroom is 4 to 3 (4:3). Fill in the table below to show classroom compositions that reflect this relationship; that is, for every 4 girls, there are 3 boys. The tape diagram below the chart makes the relationship easier to visualize.

Girls	Boys	Total Students
		7
12		
	12	

Girls: 

Boys: 

3. Write a one-sentence story problem about a ratio of your choice. Draw a diagram to represent your ratio.

____ : ____

_____

Guided Notes with Partially Completed Problems

Exemplar from:

Module 1: Topic A: Lesson 1: Ratios

Explanation of scaffold:

This scaffold supports students who require new information to be presented in smaller steps and increased opportunities to respond. It provides a structure in which difficult tasks are broken down and student practice is guided. When completed, guided notes with partially completed problems serve as a useful reference tool.

Teacher actions/instructions:

Guided notes with partially completed problems can be used with individuals, small groups, or the whole class when introducing a new skill or concept. It is best to use following a review of prerequisite skills or an opening activity and should be used in combination with teacher materials. Monitor student responses adjust instruction as needed, and fade to independent practice of the skill being taught.

The following is a model of how guided notes with partially completed problems could be used to provide structure and guidance for introducing the concept of ratios:

Example 1:

1. After modeling the first ratio table (4:1) in *Example 1* as indicated in the lesson, hand out student copies of the *Guided Notes.*
2. For the second scenario presented (3:2), use guiding questions to instruct students to complete the second row of the table in the guided notes.
3. Once students demonstrate the skill with guidance, have them complete one row in the table independently.
4. If correct, have students do a second independent practice.
5. Have students work in pairs to complete the *True/False* options.

Example 2: Class Ratios

1. Have the boys stand for a head count and write this number on the classroom board for students to see. Do the same with the girls.
2. Direct students to write the ratio of boys to girls and check for accuracy.
3. Using the class ratio, guide students in discussing and completing questions 1-6 in the guided notes.
4. Provide a model for the first answer to question 7. Fade support to independent practice.

Student actions:

Students participate in class discussion and complete the *Guided Notes* as directed.

Student handouts/materials:

Guided Notes (found on the following pages)

Guided Notes
Module 1, Topic A, Lesson 1: Ratios

Name _____ **Date** _____

Example 1

What are some other team compositions where there are three boys for every two girls on the team?

# of Boys	# of Girls	Total # of Players
3	**2**	**5**
6		**10**
		15
		20

	True	False
There are 3 times as many boys as girls.		
The ratio of boys to girls is 3 to 2.		
There are 2 times as many boys as girls.		
The ratio of boys to girls is 2:3.		

Make a tape diagram that shows there are $\frac{3}{2}$ as many boys as girls.

Boys:

Girls:

Example 2: Class Ratios

1. What is the ratio of boys to girls in our class? _____:_____

   How can we describe this relationship in words? **For every ____ boys, there are ____ girls.**

   How can we say this as a multiplicative comparison without using ratios? **There are ____ as many boys as girls.**

2. What is the ratio of number of girls to number of boys in our class? _____:_____

3. Is the ratio of number of girls to number of boys the same as the ratio of number of boys to number of girls?

   Yes/No because _____

4. Is this an interesting multiplicative comparison for this class? Is it worth commenting on in our class?

   Yes/No because _____

5. If our class had 15 boys and 5 girls, might it be a more interesting observation?

   Yes/No because _____

6. How many students in our class…

   - **Traveled out of state this summer?** _____ **Did not travel out of state this summer?** _____
   - **Have at least one sibling?** _____ **Are an only child?** _____
   - **Think their favorite class is math?** _____ **Think their favorite class is not math?** _____

7. Write a ratio for each example. Describe each relationship in words (i.e., For every_____, there are _____.

   - **A ratio for the number of students who traveled out of state this summer to the number students who did not travel out of state this summer:**

   Ratio: _____

   Description: _____

   - **A ratio for the number of students who have at least one sibling to the number of students who have no siblings:**

   Ratio: _____

   Description: _____

   - **A ratio for the number of students whose favorite class is math to the number of students whose favorite class is not math:**

   Ratio: _____

   Description: _____

Cooperative Learning

Exemplar from:

Module 1: Topic B: Lesson 9: Tables of Equivalent Ratios

Explanation of scaffold:

Cooperative learning includes those strategies where small groups of students contribute equally toward shared learning goals. This scaffold provides students of different ability levels an opportunity to engage with, assist, and learn from their peers. It motivates students to take responsibility for their own learning and can be used in any lesson to support students while they improve their understanding of a concept or skill without changing the rigor of the content.

Teacher actions/instructions:

Cooperative learning can be used at almost any point of instruction, but in mathematics, it is most beneficial after material has been presented by the teacher. This means it is best used when students are reviewing and practicing concepts or skills to reinforce their learning. It can also be used to assess student learning in the form of group or team projects and tests.

Although instructions will vary depending on the cooperative learning strategy being used, specific directions and explicit expectations should always be provided to minimize off-topic conversations and other distracting behaviors. Student groups or teams should be thoughtfully assigned and mixed heterogeneously by ability.

The following is a model of how cooperative learning could be used in this lesson:

1. Hand out student copies of exercises 1 and 2 found on pages 67 and 68 of the *Teacher Version* of the lesson (S.34 and S.35 of the *Student Materials*). Explain the assignment to students and tell them they will be using a strategy called *Think-Pair-Share* to complete it. Explain that this strategy first involves working individually, then partnering with another student to compare work, and lastly, sharing that work with the rest of the class.
2. Assign student partners by matching struggling students with those who have a better understanding of the material.
3. Give students five minutes to work individually.
4. Give students five minutes to work with their partners. During this time, students should complete and/or compare their tables and answers to the questions.
5. Direct all students' attention to the classroom board and ask for contributions from as many pairs as possible to fill in a class table that everyone can see.
6. Ask the question, "What can you say about the values of the ratios in the table?" Elicit student responses as needed.
7. All students have had three opportunities to complete and/or correct their work at this point. Students may use this work as a reference for the independent work that is required for the lesson's exit ticket if necessary.

Student actions:

Students complete their exercises using the *Think-Pair-Share* strategy as directed.

Student handouts/materials:

Copies of Exercises 1 and 2 (S.34 and S.35) from the *Student Materials*.

Instruction with Computer Technology

Exemplar from:

Module 1: Topic A: Lesson 1: Ratios

Explanation of scaffold:

Instruction with computer technology involves using computer programs and websites to increase academic engagement and reinforce understanding of concepts. This scaffold provides visual and conceptual support for students who need additional models and practice opportunities to learn new information. Videos and game applications are an engaging way for students to interact with new information, practice skills, and receive immediate feedback. Guided notes or checkout activities can be used to assist students in attending and allow teachers to check for understanding. These notes or activities can also serve as reference tools for students.

Teacher actions/instructions:

Instruction with computer technology is beneficial when introducing or reteaching a concept or skill. It can be used as a homework assignment, during whole class instruction with a smart board, or during small group or individual instruction using computers. Ensure students have the prerequisite skills for operating computers and navigating the internet. Ensure websites are accessible to all students and assistive technology needs are satisfied.

The following is a model of how instruction with computer technology could be used to introduce ratios and complement this lesson:

1. Hand out student copies of the *Guided Notes.*
2. Access the Khan Academy video, *Finding Ratios: An Introduction.*
3. Pause the video as needed to allow students to fill in their guided notes.
4. Carefully monitor students' activities to confirm on-task behaviors.

Student actions:

Students view the video and complete the *Guided Notes* as directed.

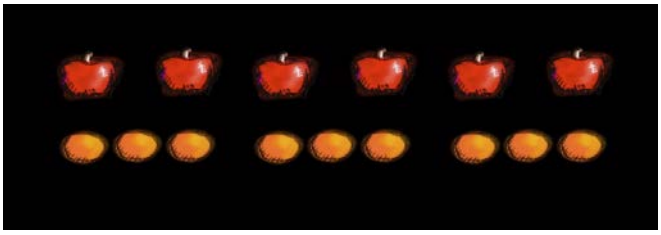
Student handouts/materials:

Computer access
Guided Notes (found on the next page)

Guided Notes

Finding Ratios: An Introduction

Name _____ **Date** _____



- **What is the ratio of apples to oranges?**

  As a ratio, we write _____ to _____ or _____ : _____

- **We can reduce 6:9 to _____ : _____ by dividing each number (group) by _____.**

  This tells us that for every _____ apples, we have _____ oranges.

- **What is the ratio of oranges to apples?**

  _____ to _____ or _____ : _____

  This tells us that for every _____ oranges, we have _____ apples.

Check for Understanding

Draw a picture that shows a ratio of 6:8 (e.g., cellphones to backpacks).

What does that ratio tell us? That for every _____, we have _____.

Concrete-Representational-Abstract (CRA)

Exemplar from:

Module 1: Topic A: Lesson 3: Equivalent Ratios

Explanation of scaffold:

CRA is a method used when teaching abstract, mathematical concepts that are difficult for students to understand. This scaffold employs a combination of a representation in the form of physical objects, a representation written on paper, and a carefully constructed arrangement of an idea or representation in one's mind. The teacher begins by modeling and thinking aloud with concrete objects (e.g., blocks, disks, etc.), then progresses to representing the concrete objects with drawings. The final level is the abstract level, where only numbers, notations, and mathematical symbols are used to complete the algorithm. Each phase of instruction builds on the previous phase to promote student learning and can help students better apply mathematical concepts to real world situations.

Teacher actions/instructions:

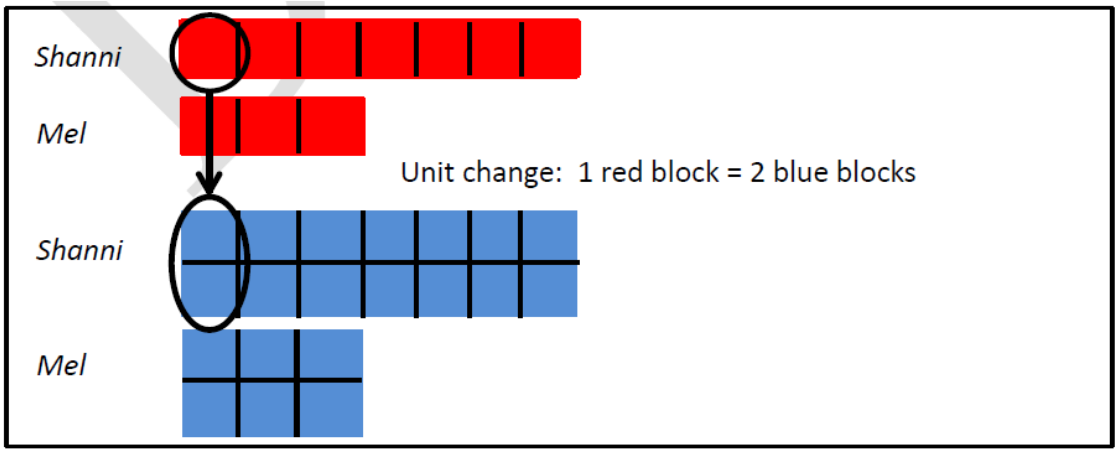
CRA can be used with individuals, small groups, or during whole class instruction when introducing a concept or teaching word problems. When using CRA, model the strategies, and provide multiple opportunities for student practice. Verbal explanations, visual demonstrations, and time for questions should be provided during each phase.

The following is a model of how CRA could be used to deepen students' understanding of equivalent ratios:

Exercise 2:

Concrete

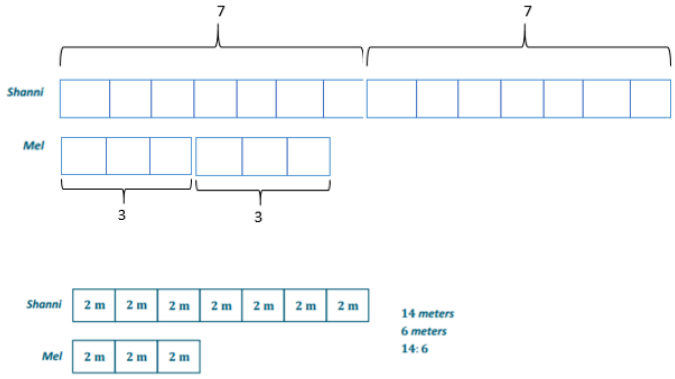
1. Provide students with cubes or blocks of two different colors (e.g., red and blue).
2. Guide students to represent 7:3 with the blocks. Provide a model if needed, using a document camera to project your work. In this case, seven red blocks placed in the first row will represent the length of Shanni's ribbon, and three red blocks placed in the second row will represent the length of Mel's ribbon.
3. Replace each red block with two blue blocks to change the unit. Now, 14 blue blocks represent the length of Shanni's ribbon, and six blue blocks represent the length of Mel's ribbon (see illustration below).



4. Explain to students that the ratio of the length of Shanni's ribbon to the length of Mel's ribbon remains the same even though the number of blocks differs.

Representational

1. Guide students to draw a tape diagram to represent the blue blocks.
2. Writing the length of each unit within the tape diagram units is suggested to further scaffold this activity. If needed, model the tape diagram for students as indicated on page 30 of the *Teacher Version* of the lesson (see illustration below).



Abstract

1. Explain the procedure for obtaining the equivalent ratio.
   - Ratio remains the same (length of Shanni's ribbon to length of Mel's ribbon = 7:3).
   - When the length of Shanni's ribbon is 14 meters, find out the number that makes 14 when it is multiplied by 7 (e.g., 7 * x = 14; x = 2).
   - Multiply both quantities of the ratio (7 and 3) by the same number (2) to derive the equivalent ratio 14:6.

2. Interpret how the ratio makes sense in the problem scenario: When the length of Shanni's ribbon is 14 meters, the length of Mel's ribbon is 6 meters.
   - $7:3 = (7 \times 2):(3 \times 2)$
     $= 14:6$

Provide modeling and guided practice as needed while students complete the sequence of problems suggested in the lesson using concrete, representational, and/or abstract means.

Student actions:

Students use blocks and tape diagrams as needed to model ratios when completing problems.

Student handouts/materials:

Blocks/cubes (two different colors)

Frayer Model

Exemplar from:
Module 1: Topic A: Lesson 1: Ratios

Explanation of scaffold:
The Frayer model is a graphic organizer that can be used in any lesson to help students understand unfamiliar vocabulary, including mathematical terms. This four-square model includes a student-friendly definition, a description of important characteristics, examples, and nonexamples. It provides a format to organize information and visual representations of the mathematical term being defined. Developing vocabulary skills is essential for students as they learn to "speak mathematically" and develop their abstract reasoning and problem-solving skills. The term *ratio* is used to demonstrate how to apply this strategy when working with students.

Teacher actions/instructions:
Select key mathematical terms. These terms should be limited in number and essential to developing a deeper understanding of the mathematical concepts or skills in the lesson.

Instruct students to complete Frayer models as follows:

1. Write the mathematical term in the middle circle.
2. Define the term, using student-friendly language, in the **Definition** box. Use your own words.
3. Write words to describe the term in the **Characteristics** box. Again, use your own words.
4. List examples of the definition in the **Examples** box. Draw a picture and/or write an equation to help you understand the term if needed.
5. List nonexamples of the definition in the **Nonexamples** box. Again, draw a picture and/or write an equation if needed.
6. Test yourself.
   - The study step is critical to student success in using vocabulary strategies such as the Frayer model. Students need to study the terms to internalize them for later use.
   - Students can quiz each other during "down times," or the models/cards can be used as part of a center activity.

Student actions:
Students work either individually or in pairs to make and study Frayer models.

Student handouts/materials:
Frayer Model template (found on page 16)

NAME: _____

Frayer Model (example)

Definition

A **ratio** is a comparison of two numbers or two quantities by division that indicates how much of one thing there is compared to the amount of another.

Characteristics

An ordered pair of non-negative numbers, which are not both zero, used to show a comparison.

Ratios can be written three ways:

$A : B$, A to B, or $\frac{A}{B}$

Order of the numbers is important to meaning.

Ratio

Examples

Ratio of red squares to blue triangles can be written as 3 to 4, $3 : 4$, or $\frac{3}{4}$

For every 3 red squares, there are 4 blue triangles.

The co-ed soccer team has four times as many boys on it as it has girls. The **ratio** of boys to girls is $4 : 1$.

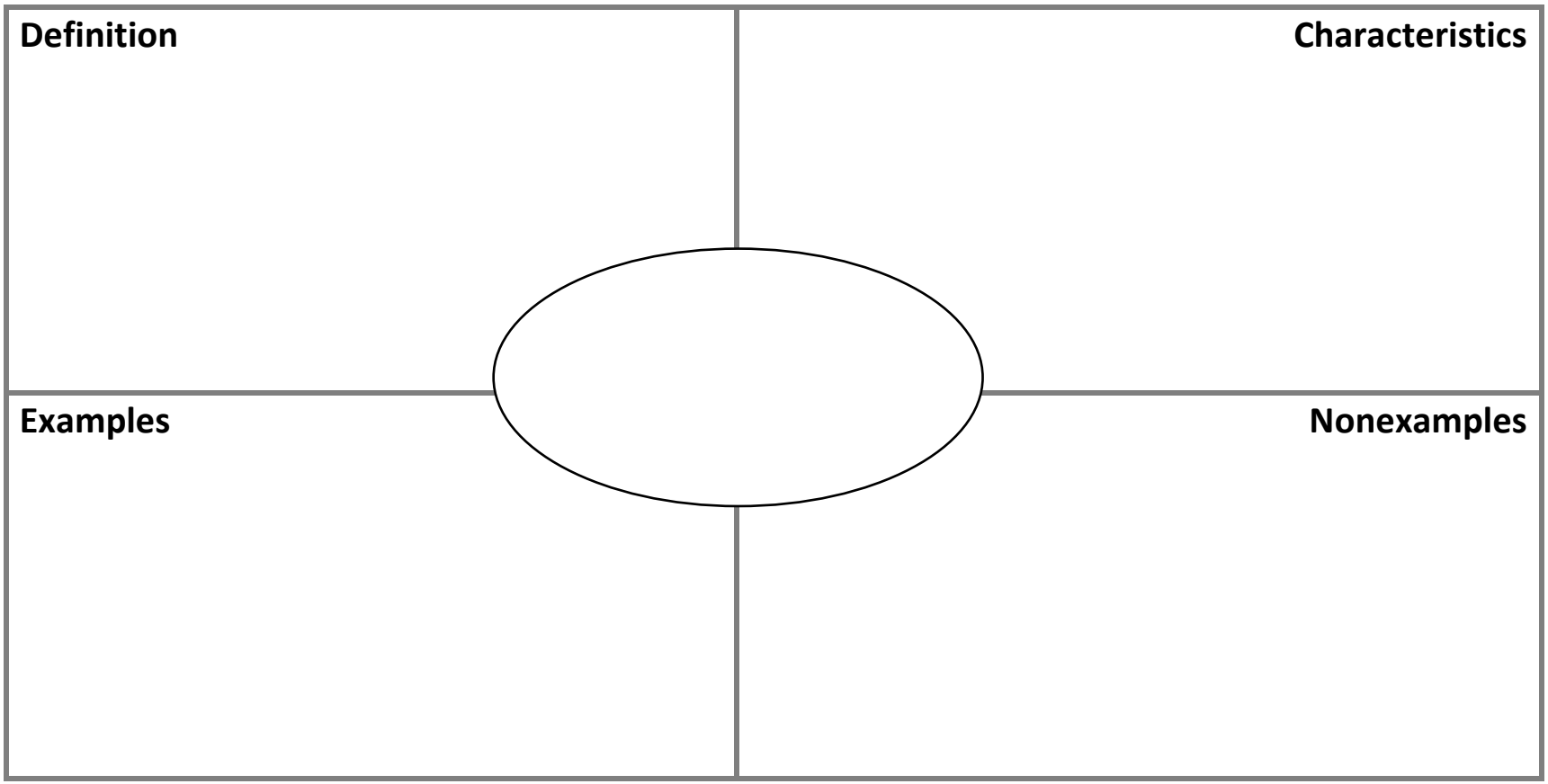
Nonexamples

Ratio of red squares to blue triangles:

3×4	3 = 4	3 + 4
4 to 3	$3 : 7$	$\frac{4}{7}$

NAME: _____

Frayer Model



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