



## Math Lab Lesson #6: Multiplying Binomials and Factoring Quadratics

*How can we multiply binomials using the area model?*

*How can we factor quadratic expressions and solve quadratic equations?*

### SITUATING THE LESSON:

**During Saturday Academy and Weekday, students have:**

- Discovered a relationship between fractional exponents and roots by noticing that  $\sqrt{x}$  and  $x^{\frac{1}{2}}$  respond to operations in an identical way. They extended this to conclude that  $x^{\frac{a}{b}} = \sqrt[b]{x^a}$ , and practiced manipulating exponential expressions.
- Over the next few weeks, they will learn how to solve radical equations.

**Summary:** In this lesson, students will:

- Review how to multiply binomials and factor quadratics in order to prepare for solving radical equations in upcoming Saturday Academy/Weekday lessons.
- Explore these concepts geometrically by using Algebra Tiles (Group Activity)
- Practice multiplying binomials and solving quadratic equations by application of the zero-product rule (Videos)

**Preparation Before Class:** Work through all problems and watch videos in advance. Read through and annotate the Lesson Plan in a way that will be useful to you.

**Materials:** (NOTE: PLEASE PRINT LESSON PLAN IN COLOR)

- **Math Lab Lesson #6: Classwork** (1 per student and instructor)
- **Math Lab Lesson #6: Group Activity** (1 per student and instructor)
- **Math Lab Lesson #6: Instructor Answer Key** (instructor only)
- **Algebra Tiles** (class set, see Lesson Plan)
- **Blue and Red pencils** (1 of each per student)
- **Blank Note Cards** (at least 5 per student)
- **Whiteboards and Dry Erase Markers** (1 per pair of students)



## 1<sup>st</sup> Hour

### 1. Lesson Launch (15 min)

#### A) SATURDAY ACADEMY AND WEEKDAY REVIEW

- Ask students what they have been learning in Saturday Academy and Weekday (if applicable). What has been interesting? What have they struggled with? Take a few responses and jot them on the board.
- Ask students to take out their Classwork (or Homework or Daily Double) from Saturday Academy and find a problem that they feel confident that they understand. Have students pair up and use a whiteboard to explain their work to their partner. After a few minutes, have them switch who is explaining and repeat. Circulate and listen.

#### B) REVIEW KEY IDEAS

- Bring the whole class together again, and ask a few students to share out what they just learned from their partner. Review any key ideas and common mistakes that you noticed as you circulated.

### 2. Group Activity and Presentations (40 min)



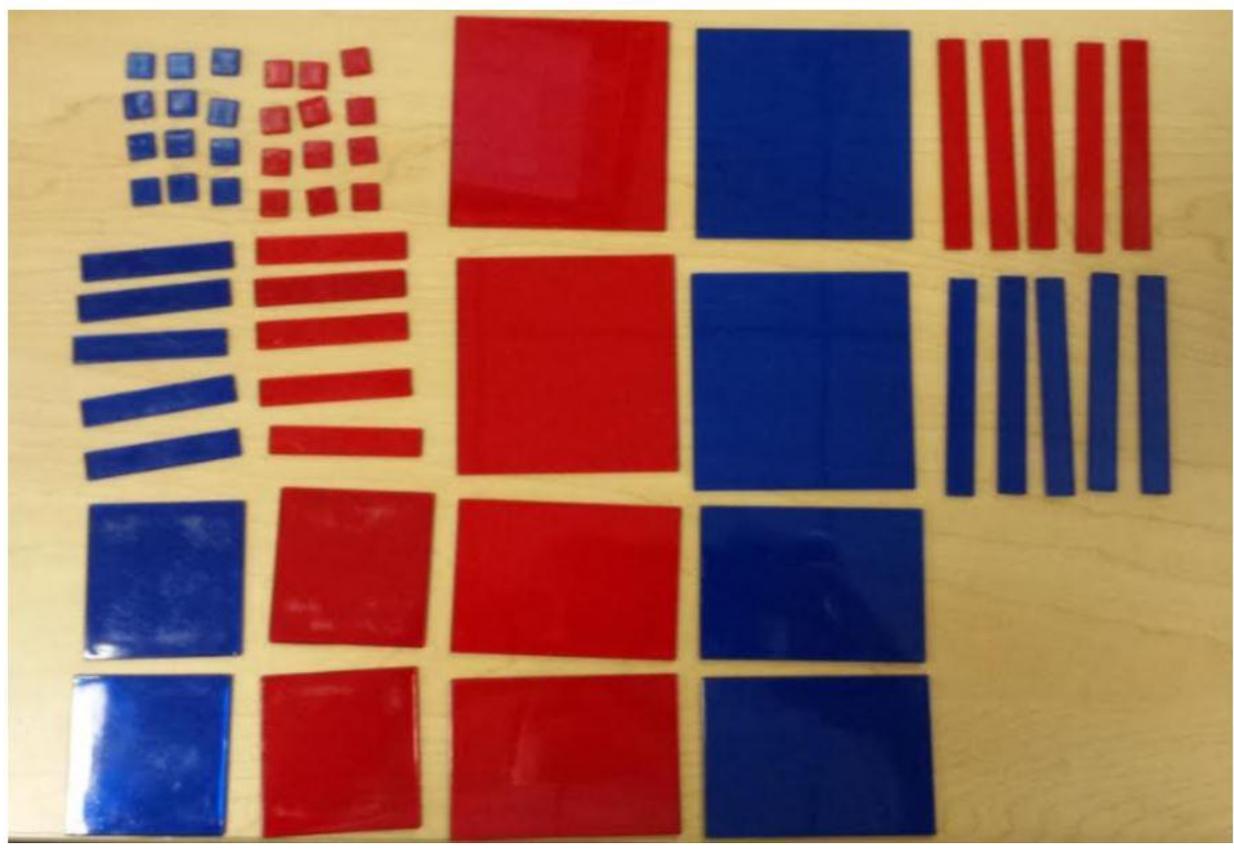
**TEACHER NOTE:** This lesson is a review of how to multiply binomials, factor simple quadratic expressions, and solve quadratic equations. The latter skills are used as part of the multi-step process of solving radical equations, which students will learn about later in the Semester, as well as solving rational equations (which students will learn about next Semester). Historically, students have a difficult time multiplying binomials out, for example writing:  $(x + 5)^2 = x^2 + 25$  instead of  $x^2 + 10x + 25$ . Since this algebraic skill is so important in a variety of mathematical content areas, we will spend this lesson addressing some of the confusion.

#### A) ACTIVITY LAUNCH

Hand out the Group Activity and whiteboards. Have students work on the activity launch, then share out. If students come up with the correct method of multiplying, ask them “why does this work?” Some students may know “FOIL”, for example, but have no idea what it means or why it works.

B) ACTIVITY

- Group students based on the number of complete sets of Algebra Tiles that you have. Below is what a complete set consists of:



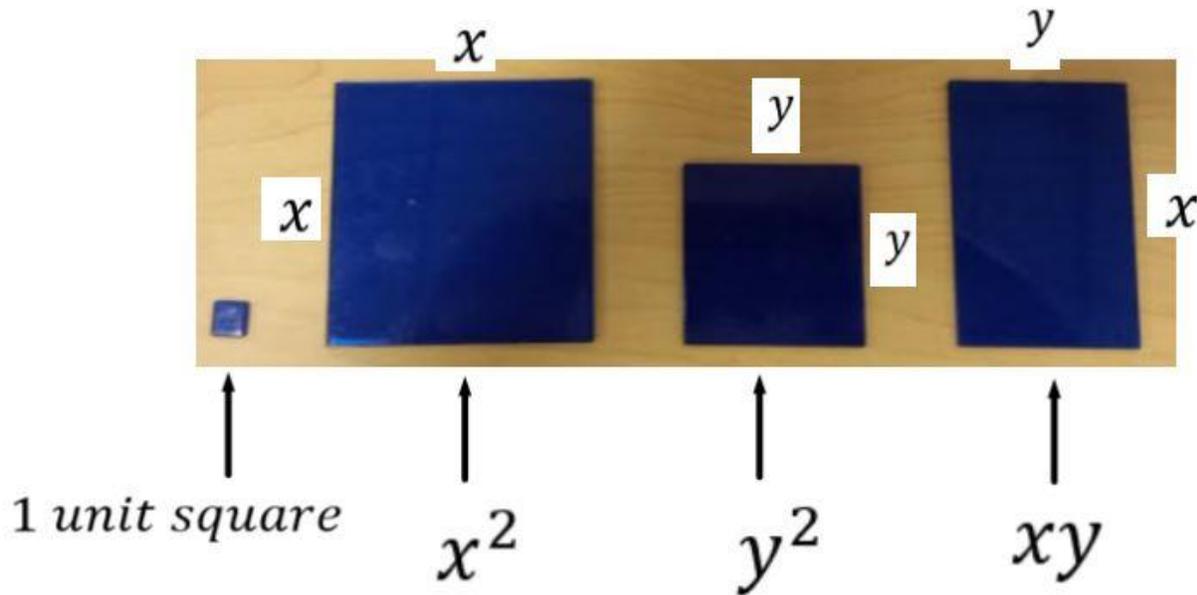
Each group should also have two rods that you can fit together like this:





Hand out Algebra Tiles and colored pencils. Algebra Tiles are a manipulative to help students learn how to multiply polynomial expressions. Here is how the Algebra Tiles work:

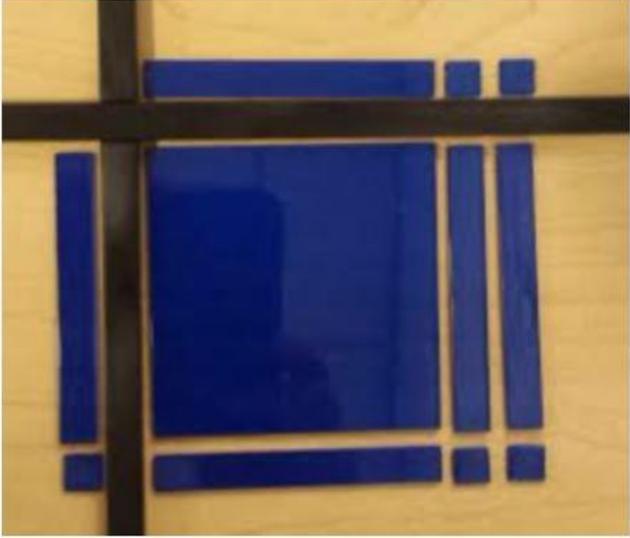
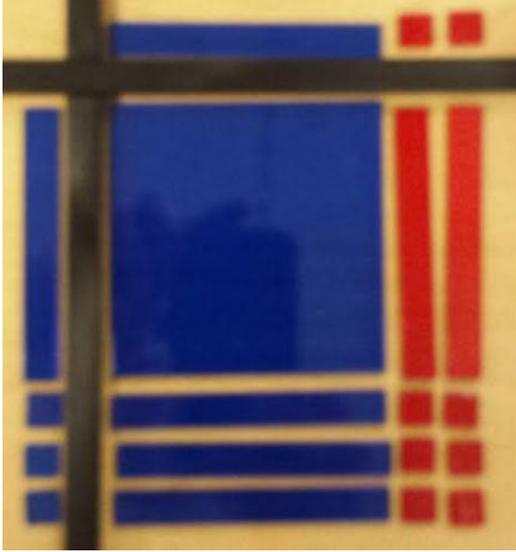
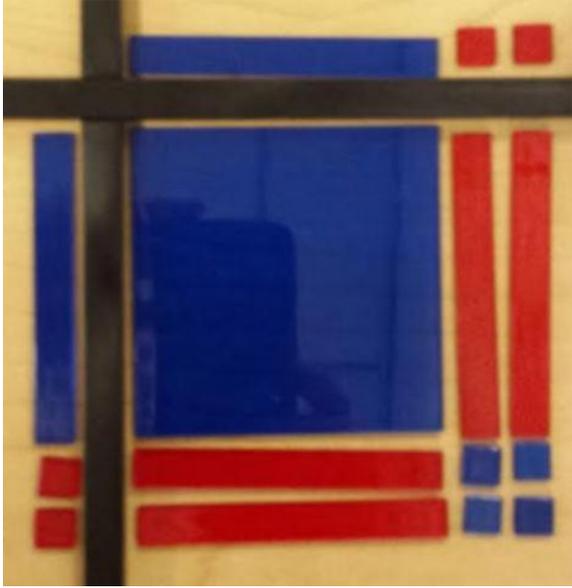
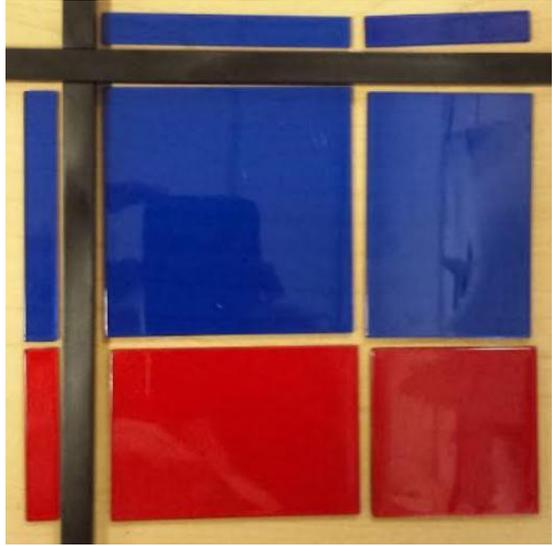
- **Blue** tiles represent **positive** values, and **red** tiles represent **negative** values.
- Here is what some of the square tiles represent:



- Students also have tiles with length  $x$  and width 1, and tiles with length  $y$  and width 1.
- The rods are used to separate the linear factors that are being multiplied. The two linear terms being multiplied are represented on the exterior of the rods, and the product is represented on the interior (see pictures on next page).
- Students need to make sure to use the correct color tile to represent the product: blue tiles should be used to represent the positive values  $(+) \times (+)$  and  $(-) \times (-)$ , and red tiles should be used to represent the negative values  $(+) \times (-)$ .
- Students should use the colored pencils to complete the activity.



- Here are some examples:

 $(x + 1)(x + 2) = x^2 + 2x + 1x + 2$	 $(x + 3)(x - 2) = x^2 + 3x - 2x - 6$
 $(x - 2)^2 = x^2 - 2x - 2x + 4$	 $(x - y)(x + y) = x^2 + xy - xy - y^2$

Explain these rules to students, and show them  $(x + 1)(x + 2)$  and  $(x + 1)(x - 2)$  on the board (using different colored markers). Then have them complete the Group Activity.

### 3. Break (5 min)

- Snacks and chill.



## 2<sup>nd</sup> Hour

### 4. Math Lab Videos (40 min)

- Hand out the Classwork and a few flashcards. and help students access the following videos. They are located on seoscholars.org → For Students → Resources → Learning Portal → Math Lab.

- Video #1: Multiplying Binomials and the Area Model
- Video #2: Factoring Quadratics

- Direct students to **take notes on the videos on their Classwork**. Let them know that they should feel free to pause or rewind the video if anything is unclear, and they should raise their hand if they would like you to help them one-on-one. Circulate, keep students on track, and provide hints and help as needed.

- Tell students to **answer any questions embedded in the video**.

- Once a student has finished watching a video, they should **complete the Classwork problems that relate to that video**.

- After watching a video and completing the Classwork, they should **create one or two flashcards that relate to what they learned from the video**.

- Explain that you can create and use flashcards to study math concepts in the same way that you use them to learn vocabulary.
- You can write examples, key ideas, definitions, or even pictures.
- **If necessary, model how to study with flashcards:** introduce one flashcard at a time, and mix them up as you study so you don't memorize them in a particular order.

- Once they have finished, they should go to the next video.

➡ **TEACHER NOTE:** Students will go at different paces. In fact, that's one of the benefits of video-based instruction. If some students finish before other students, feel free to have them discuss their answers with each other, or practice studying with their flashcards. They can even work on their Saturday Academy Homework (although make sure not to go over answers to this HW so that their Saturday Academy instructors will have data that the need to accurately assess student performance).



## 5. Closing (15 min)

### A) MATH LAB PARKING LOT

- There will be chart paper on the wall titled “Math Lab Parking Lot.” This is for students to use to bring up any questions that they have that relate (somewhat) to math. For example:
  - **Are you unsure about some idea that you learned in your SEO math class?**
  - **Are you unsure about some idea that you learned in your regular school math class?**
  - **Are you curious about something that is related to math that you saw on TV or that you heard about in the news?**
- Give students these prompts as an example of the types of questions that they can bring to add to the Parking Lot.
- Explain that each week, you will spend 5 – 10 minutes at the end of class answering these Parking Lot questions. See if anyone has any questions and write them on the Parking Lot (or have students do this). When there are a bunch, answer one if there is time.

### B) REFLECTION WALL

- There will be chart paper on the wall titled “Math Lab Reflection Wall.” If they haven’t already, have them decide their Math Lab Team name (build a little competition into this) to add to this chart paper.
- Explain that each week, they will be asked to come to the reflection wall and write a response to a prompt. This week, the prompt is:

**My favorite part of Math Lab this semester has been \_\_\_\_\_ because \_\_\_\_\_.**

- After all students have written a response to this prompt somewhere on the butcher paper, dismiss the class.