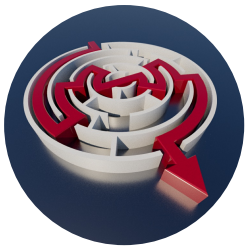

Finding Factors, Part 2

Factoring Polynomials

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Grade Level	10th – 11th Grade	**Time Frame**	105-130 minutes
Subject	Mathematics	**Duration**	2-3 class periods
Course	Algebra 2		

Essential Question

How are polynomial equations solved?

Summary

In this lesson, students will recall expanding polynomials and factoring quadratics. Students will learn how to factor polynomials with two, three, or four terms: difference of two squares, sum or difference of two cubes, trinomials of the quadratic form that are not quadratics, and grouping. Students will use this knowledge to factor and solve (factorable) polynomials. This lesson is not intended to be taught immediately after the Finding Factors, Part 1 lesson, but rather after students finish learning about quadratic functions.

Snapshot

Engage

Students recall the relationship between *x*-intercepts of a graph and the intercept form of a quadratic.

Explore

Students match expanded and factored forms of polynomial expressions to solve a diamond puzzle.

Explain 1

Students complete guided notes with the class and formalize their understanding of factoring two-term polynomials.

Extend 1

Students apply what they have learned to factor two-term polynomials.

Explain 2

Students complete guided notes with the class and solidify their understanding of factoring polynomials that are of the quadratic form or use grouping.

Extend 2

Students apply what they have learned to factor polynomial expressions and solve polynomial equations through a Choice Board.

Evaluate

Students reflect on their learning and demonstrate their understanding by creating a flowchart about the process of factoring.

Standards

Oklahoma Academic Standards for Mathematics (Grades 9, 10, 11, 12)

A2.A.1.4: Solve polynomial equations with real roots using various methods and tools that may include factoring, polynomial division, synthetic division, graphing calculators or other appropriate technology.
A2.A.2.1: Factor polynomial expressions including but not limited to trinomials, differences of squares, sum and difference of cubes, and factoring by grouping using a variety of tools and strategies.

Attachments

- Diamond Puzzle—Finding Factors, Part 2.docx
- Diamond Puzzle—Finding Factors, Part 2.pdf
- Factor Finder—Finding Factors, Part 2.docx
- Factor Finder—Finding Factors, Part 2.pdf
- Get Your Factors Straight—Finding Factors, Part 2.docx
- Get Your Factors Straight—Finding Factors, Part 2.pdf
- Guided Notes—Finding Factors, Part 2.docx
- Guided Notes—Finding Factors, Part 2.pdf
- Lesson Slides—Finding Factors, Part 2.pptx
- Perfect Pairings—Finding Factors, Part 2.docx
- Perfect Pairings—Finding Factors, Part 2.pdf

Materials

- Lesson Slides (attached)
- Perfect Pairings handout (attached; one per student; printed front only)
- Diamond Puzzle handout (attached; one per pair; printed front only)
- Guided Notes handout (attached; one per student; printed front/back)
- Factor Finder handout (attached; one per student; printed front only)
- Get Your Factors Straight handout (attached; one per student; printed front only)
- Pencils
- Paper
- Scissors
- Coloring utensils (optional)
- Poster paper (optional)
- "Finding Factors, Part 1" (optional; lesson series)

10 minutes

Engage

Teacher's Note: Lesson Order

The order of this lesson is as follows: Engage, Explore, Explain 1, Extend 1, Explain 2, Extend 2, Evaluate.

Introduce the lesson using the attached **Lesson Slides**. **Slide 3** displays the lesson's essential question. **Slide 4** identifies the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Display **slide 5** and give each student a copy of the attached **Perfect Pairings** handout. Instruct students to work individually to match each given graph with each given equation.

Move to **slide 6**. Using the Inverted Pyramid strategy, have students find a partner to discuss how they matched the graphs and equations. Guide students to work with their partner to then write the equation for the last graph on their handout.

After a few minutes, show **slide 7** and have each pair of students find another pair of students (creating groups of four) to compare their results and reasoning.

After a few minutes, bring the class together for a whole-group discussion. Have one student from each group share their equation and reasoning with the class.

Use student responses to see if the class needs a quick review of the relationship between the intercept form of a quadratic and the *x*-intercepts of a parabola. If needed, guide the conversation so that students draw the logical conclusion that a polynomial could cross the *x*-axis more than twice and that there is a relationship between the factored form of a polynomial and its *x*-intercepts.

15 minutes

Explore

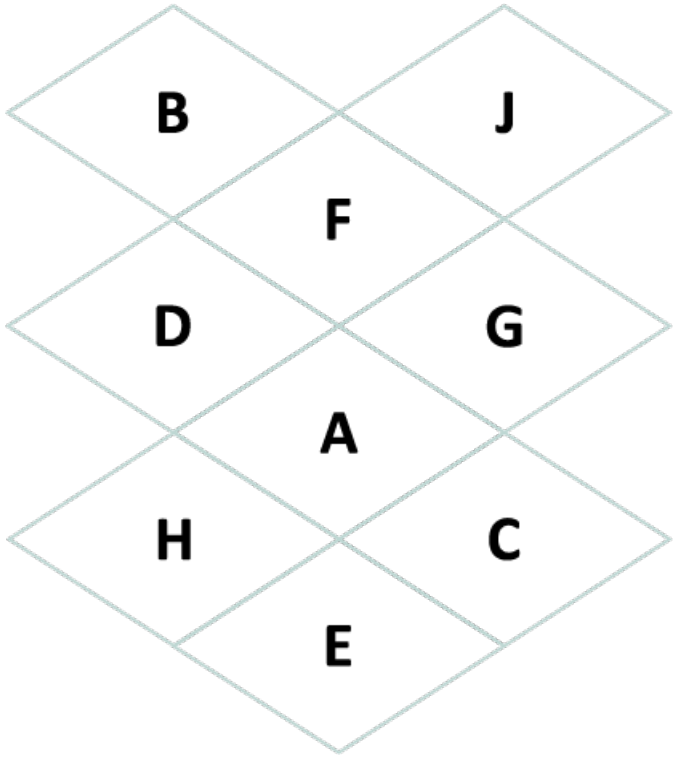
Teacher's Note: Lesson Differentiation

Consider removing the template image from slide 8 to increase the rigor of the puzzle for students who are apt for the challenge.

Instruct students to find their original partner or to find a new partner. Display **slide 8** and inform students that they will be practicing expanding polynomials. Pass out scissors and a copy of the attached **Diamond Puzzle** handout to each pair of students.

Direct students to cut out the nine diamond tiles. Have students rearrange the tiles into the pattern shown on the slide so that the sides touching are equivalent factored forms and expanded forms of the same expressions.

As students work together to solve the puzzle, use the image below as a quick way to check students' work. This image is also available on the hidden **slide 9**.



Teacher's Note: Guiding the Activity

Even though it is tempting, do not give students the answer to this puzzle. Give students time and allow them to have a healthy struggle. It is also important that students do not get frustrated and give up. To help with this balance, consider giving the following hints, depending on students' needs:

- Give feedback for correct matches.
- Help them place their correct matches in the correct place of the bigger puzzle. For example, "H, E, and C are correctly matched but are in the wrong places."
- If students are struggling to start, tell them where one tile goes. For example, "Tile B should be placed in the top-left corner of the puzzle."

15 minutes

Explain 1

Display **slide 10**. Give each student a copy of the attached **Guided Notes** handout and complete the front side as a class.

After completing example 1 from the handout, which is attempting to factor x^2+16, show how to factor x^2-16 and then compare and contrast the two expressions. Help students understand why a sum of two squares is unfactorable.

Teacher's Note: Reference List

If students are struggling to identify perfect squares or perfect cubes, consider having students create a quick-reference list like the example below. Make the reference list as long as you see fit to meet the needs of your students.

- Perfect Squares.....Perfect Cubes
  - $1^2=1$.....$1^3=1$
  - $2^2=4$.....$2^3=8$
  - $3^2=9$.....$3^3=27$
  - ...

Teacher's Note: ACT Prep

Regarding the sum or difference of two cubes, students just need to recall the first factor. On the ACT, students are occasionally asked to factor a sum or difference of two cubes. Often the available options require students to recall which operation goes into the first factor: $(a+b)$ or $(a-b)$. Sometimes they will also need to recall that the second factor's middle term has the opposite operation but not need to recall any additional details of that second factor. Pattern recognition is what is really being assessed.

After completing only the front side of the handout, direct students to set it aside. Students will complete the back side later in the lesson.

20 minutes

Evaluate

Teacher's Note: Activity Preparation

During this portion of the lesson, students will create flowcharts that another student could use to learn how to factor polynomials. Consider what you would like students to do with their completed flowcharts. They could:

- Display them on the wall for students to reference.
- Use poster paper and coloring utensils to make their flowcharts into Anchor Charts.
- Trade flowcharts and use their peers' flowcharts to factor polynomials (if time allows or as later review or practice).
- Use notebook or copy paper—or even tape multiple sheets of paper together—to create their flowcharts.

Regardless of what you choose, it is likely that students will need a place to plan their flowcharts and a place to put their finished ideas.

Optional Technology Integration

If you would like students to digitally create their flowcharts, have students use Google Drawings. Keep in mind that a digital creation will likely double the amount of time needed for this activity.

Give students the following advice for using this tool to create a digital flowchart:

- Use copy and paste for the flowchart shapes (and some text).
- Select "Insert," then hover over "Shape" to find the options for shapes to insert.
- Double-click on the shape to add text.
- Select "Format," then hover over "Text" to find the superscript option for exponents.

Display **slide 26** and introduce students to the idea of a flowchart. The shapes in a flowchart indicate meaning, as indicated on the slide.

Give students paper (and coloring utensils if you prefer) and direct them to work with their partner to create their own flowchart that another student could use to learn how to factor polynomials. Communicate your expectations of this project with students.

Optional Scaffolding

Unhide and use **slide 27** if needed to help students get started.

Resources

- K20 Center. (n.d.). Anchor Charts. Strategies. https://learn.k20center.ou.edu/strategy/58
- K20 Center. (n.d.). Card Matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). Choice Boards. Strategies. https://learn.k20center.ou.edu/strategy/73
- K20 Center. (n.d.). Google Drawings. Tech tools. https://learn.k20center.ou.edu/tech-tool/629
- K20 Center. (n.d.). Inverted Pyramid. Strategies. https://learn.k20center.ou.edu/strategy/173