

Lesson: Factoring Polynomials: Saving Santa Breakout

Lesson Overview In this lesson, students will work to factor polynomials to decode the clues and combinations for a breakout opportunity.

Standards Addressed *Content(s) Standard Number(s) and Descriptor(s):*

AAPR.1*: Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations.

ASE.2*: Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

Computational Thinking

Tools:

Breakout (*virtual*)

Cornerstone(s) Addressed:

- Decomposition – students decompose polynomials into the factors of the polynomial.
- Pattern Recognition – students must consider patterns or number combinations when considering signs of coefficients and/or constants when working to factor the polynomial.
- Algorithmic Thinking – students must find the order of the terms in the factored expressions by applying steps and procedures.
- Abstraction – students must identify the most effective and efficient solutions.

Lesson Plan

Time required: two 55-minute class periods

Focus Question(s): How might you factor polynomials with either 3 or 4 terms and use the knowledge to crack the codes in the breakout?

Disciplinary Vocabulary: factor, factoring, polynomial, binomial, trinomial, exponent, degree, constant, coefficient, grouping, common factor, simplified terms, term

Materials needed:

- Chromebooks (or other device) with internet access
- Math notebook
- 3 index cards or post-it notes per student
- Dry erase boards or paper/pencil for each student

Engage

Provide students with the following scenario. “Santa has a huge problem! His elves have been working so hard to improve security that they changed some of the codes around the North Pole... the only problem is that they have forgotten the codes. Now Santa's sleigh is locked away, and they need your help to get to it before Christmas is ruined for everyone! The Elves need to get into Santa's workshop, find all the codes for the locks and ignitions.... and even get past the guard elves. Help them before it is too late. Good Luck!”

Explore

Students work in the virtual breakout to review vocabulary terms and factor polynomials in order to breakout.

NOTE: The breakout includes instructions, clues, and problems to solve.

Locks:

Santa Workshop Alarm Code: 2244 (from the deck toy)

Magical Telescope: common factor

Garage Padlock: 6243

Guard Elves Pass-code: Presents

Sleigh Ignition Switch: 51521743 (8-digit constants ordered)

Explain

Students move back to seats to debrief learning. Students should be placed in groups other than those they worked in for the breakout. Students should discuss how they solved the different parts of the breakout, the procedures used, the learning and questions they still have. The teacher should lead a class discussion on each part of the breakout to ensure student understanding.

Elaborate

Students will be able to practice factoring procedures for trinomials and connect polynomial and factored forms of expressions.

Students will be given 3 index cards or post it notes and a dry erase board or paper/pencil.

- Students start with two self-created binomials with each leading term having an exponent of 1 and each binomial NOT having common factors within its two terms. Then they should multiply them out to form a 3-term polynomial in the form of $y = ax^2 + bx + c$. Tell students they may choose to have a constant term in front of the two binomials to also distribute through the 3-term polynomial. NOTE: This will require students to factor out common denominators prior to factoring later in this section.
 - Give the following as examples/non-examples
 - $(x - 5)(2x + 3)$ - multiply out
 - $5(x - 5)(2x + 3)$ - multiply binomials first, then distribute the 5 through
 - NOT allowed: $(5x - 5)(2x + 3)$ since the first binomial has a 5 as a common factor and is not in simplified terms
- On the first card/note students will write the two binomials only. NOTE: Students will hold on to the card/note they wrote their original problem (the two binomials) on. This is the factored form of the polynomial.

Card 1: $(x - 5)(2x + 3)$

- Then, the polynomial generated will be written on the front of the second index card/note.

Card 2: $2x^2 - 7x - 15$

- The index cards (with the polynomial only) will be passed to another student in the room. Trades should be made until no student has their own card.

Card 1 now is still: $(x - 5)(2x + 3)$

Card 2 is NEW from trade: $3x^2 + 2x - 8$

- Students should work to factor the polynomial they currently have and write the factored form on another index card/note. Students will keep these cards.

Card 1 now is still:

$(x - 5)(2x + 3)$

Card 2 is still:

$3x^2 + 2x - 8$

Card 3 is NOW:

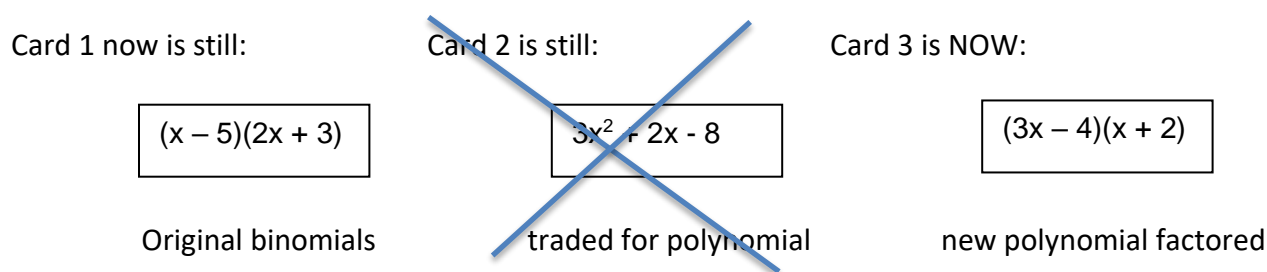
$(3x - 4)(x + 2)$

Original binomials

traded for polynomial

new polynomial factored

- The teacher will collect the cards with the polynomials written on them.
- Students should now have their original factored form for their polynomial AND the factored form for the polynomial card they were traded.



- The teacher will say, “I have (the polynomial)” and the student(s) with the factored binomials matching the polynomial will stand. Students will need to work each problem to see if their factored form matches the polynomial called. The teacher should also write the polynomial on the board or under a document camera, etc. to display what is called.
 - NOTE: Two students will have the factored form of any given polynomial. The one who originated the card and the one who worked the polynomial card once traded.
- Students may use a dry erase board or a piece of paper to demonstrate how their binomials multiply to form a polynomial and write the polynomial on the paper with the binomials.
- The first to stand will justify what they have on their card and how it matches. The student who stood second will verify or alter the response.

NOTE: A similar exercise might be used to reiterate factoring of a 4-term polynomial.

Evaluate

Students should be given a 3-term polynomial with ax^2 as the leading term AND a 4-term polynomial with ax^3 as the leading term. Students should work in pairs to factor each and complete a t-chart on similarities and differences in the two types of problems. These polynomials can be generated at random or found from student sample practice problems. Give the students their polynomials on a slip of paper. Have them write them on the handout (attached) and complete the similarities/differences t-chart. *NOTE: Make sure the polynomials factor as this is the content of this lesson. These should be submitted to the teacher for accuracy and content knowledge to be assessed.*

Assessment Notes:

Use the elaborate portion of this lesson to discuss incorrect answers or misconceptions before students do the evaluate portion of the lesson.

Resources:

Link to the Saving Santa Breakout: <https://sites.google.com/view/factoring-santa/home>

Teacher Biographical Information

Lesson Author: Mrs. Deborah Waters, 8 years teaching high school math, BS: Mathematics – Minor: Education

Polynomials Similarities/Differences

Trinomial

4-term Polynomial

Factors: _____

Factors: _____

Work:

Work:

Consider: Factoring Methods, Process/Steps, Exponent Values, etc.

Similarities	Differences