Can You Save the World in Time?
Exponent Rules: Digital Breakout

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Grade Level	8th Grade	**Time Frame**	2-3 class period(s)
Subject	Mathematics	**Duration**	90 minutes
Course	Middle School Mathematics		

Essential Question

How can properties of integer exponents create expressions?

Summary

This lesson addresses rules for exponents. Students will discover the rules for exponents through an exploration of numerical expressions and visual representations of exponents. Prerequisites for this lesson include an understanding of the components of an exponent. This lesson allows students to explore digital breakouts while using rules of exponents.

Snapshot

Engage

Students will watch a video of growing bacteria to observe the exponential growth rate of an epidemic breakout.

Explore

Students will discover rules of exponents through numerical, visual, and conjectures.

Explain

Students will clarify and create exponent rules from exploration activity.

Extend

Students will complete a digital breakout using rules of exponents.

Evaluate

Students will complete us a Muddiest Point strategy to identify information that needing clarification.

Standards

Oklahoma Academic Standards for Mathematics (Grade 8)

PA.N.1.1: Develop and apply the properties of integer exponents, including $a^0 = 1$ (with a ? 0), to generate equivalent numerical and algebraic expressions.

Attachments

- [Components of Exponents Handout - Spanish.docx](#)
- [Components of Exponents Handout - Spanish.pdf](#)
- [Components of Exponents Handout.docx](#)
- [Components of Exponents Handout.pdf](#)
- [Exponent Rules—Digital Breakout slides.pptx](#)
- [Muddiest Point Exit Ticket - Spanish.docx](#)
- [Muddiest Point Exit Ticket - Spanish.pdf](#)
- [Muddiest Point Exit Ticket.docx](#)
- [Muddiest Point Exit Ticket.pdf](#)
- [Rules of Exponents Handout - Spanish.docx](#)
- [Rules of Exponents Handout - Spanish.pdf](#)
- [Rules of Exponents Handout.docx](#)
- [Rules of Exponents Handout.pdf](#)
- [You Found the Cure Handout - Spanish.docx](#)
- [You Found the Cure Handout - Spanish.pdf](#)
- [You Found the Cure Handout.docx](#)
- [You Found the Cure Handout.pdf](#)

Materials

- Exponent Rules: Digital Breakout slides
- "Components of Exponents" handout
- "Rules of Exponents" handout
- "You Found the Cure" handout
- "Muddiest Point Exit Ticket" handout
- Computers/Laptops or other internet-connected devices

Engage

Begin the slide show, introducing the lesson and the Essential Question on slide two: "How can properties of integer exponents create expressions?" Set the stage by telling students that today they will form "medical" teams to find a cure for a growing epidemic. They'll need to be successful in order to save the world!

Show slide 4 and introduce an I Notice, I Wonder strategy by asking students to make a T-chart in their notebooks. Have them label the left-hand side of the chart, "I Notice…" and the right-hand side, "I Wonder…"

Teacher's Note: I Wonder

"I Wonder…" responses can sometimes be difficult for students to come up with. Have students think of this in terms of listing any questions they have about the video.

Transition to slide five. Show the 15-second bacteria video (the full URL is listed in the Resources below as well). After the video, have students fill in at least one thing they noticed in the left-hand side of their chart. Then have the students fill in at least one thing they wonder in the right-hand side.

Lead a whole-class discussion on the students' "I Notice…" and "I Wonder…" statements. You can use slide six to jot record observations for the class to see. This will help with creating a background story and visual reference for students to retain for the Extend storyline later in this lesson.

Sample Responses:

Sample student responses to this activity might include, "I notice the speed that the bacteria grows," or "I wonder why it grows so fast?" among others. Encourage as many different answers as possible.

Explore

Pass out the Components of Exponents handout. Group students in pairs to complete the handout.

> **Teacher's Note: Completing Handouts**
>
> It is recommended that students complete the Components of Exponents handout first prior to the Rules of Exponents handout. This allows for misconceptions about exponents to be clarified before students explore their rules.

Display slide 10. The Components of Exponents handout allows students to work with exponents to understand the components of a power. Students will demonstrate their knowledge through expanded notation (not using exponents), numerical notation through standard notation, and visually.

> **Teacher's Note: Lesson Sequence**
>
> For this lesson, you will skip to the Explain section to complete the Components of Exponents handout, then come back to the Explore to complete the Rules of Exponents handout.

Skip to the Explain for Components of Exponents.

After the Explain for Components of exponents, have students complete the Rules of Exponents handout.

The Rules of Exponents handout allows students to discover the rules for operations with exponents. Following the example given, students will write numerical expressions, write a rule, and demonstrate the rule. Slides 15 through 19 break down the handout into sections that you can display to guide the discussion of each rule.

> **Teacher's Note: Group Work And Scaffolding Instruction**
>
> This is a time for students to ask questions within their groups. You can edit the handout and slides to provide more scaffolding if needed.

Skip to the Explain for Rules of Exponents.

Explain

Explain for Components of Exponents:

Display slide 20 and Introduce an [Inverted Pyramid](#) strategy. Have students join with another pair to discuss the exponent components they discovered. After a few minutes, have the new group of four students join another group of four to discuss the components. After another few minutes, come together for a whole-class discussion about what components or patterns the students discovered with the exponents.

> **Teacher's Note: Using The Inverted Pyramid**
>
> Teacher Note: This strategy is called the Inverted Pyramid. This allows students to work out misconceptions within small groups before the whole-class discussion.

Have students return to their original pairs and complete the Explore for Rules of Exponents, before moving on to the Explain for Rules of Exponents.

Explain for Rules of Exponents:

Ask students use the Inverted Pyramid strategy again. Have students join with another pair to discuss the exponent rules they discovered. After a few minutes, have the new group of four students join another group of four to discuss the rules. After another few minutes, come together for a whole-class discussion about what rules or patterns the students discovered with the exponents.

> **Teacher's Note: Understanding Rules Before Moving On**
>
> Students will need to understand the rules of exponents in order to complete the digital breakout in the Extend.

Extend

Display slide 22. Have students return to their original pairs or re-pair them as you feel is needed. Each pair will need Chromebook, iPad, computer, or another device to access the Epidemic Breakout . (The full URL for the website can be found in the resources below and in the slide show.)

> **Teacher's Note: Digital Breakouts**
>
> Digital breakouts allow students to work collaboratively to solve a series of critical thinking puzzles and open a virtual "locked box." If you would like more information about digital breakouts and further resources, visit this website before the students work on the following digital breakout.

Students will need to find the clues hidden in the digital breakout in order to "save the world." Each clue covers one of the exponent operations. Once a clue is completed, it will create a key to be typed in the space provided. Once all five keys are found, students will then submit the form. The form will notify the students if they entered an incorrect key. Once students have completed the breakout, distribute one "You Found the Cure!" handout to each pair. Students should enter the code, note where they found it, and how they solved for the clue.

Evaluate

Display slide 24. Use a [Muddiest Point](#) strategy to have students complete the attached [Exit Ticket.](#) Ask your students "Of everything we have learned today, what do you feel most confident about? What is "crystal clear" to you?" Then ask them, "What do you feel least confident about? In other words, what is your "muddiest point" from today?" Give students time to think and answer both questions.

Use students' responses to evaluate their knowledge and to determine what needs to be revisited during the next instructional opportunity.

Resources

- Digital Breakouts. (n.d.). Retrieved from https://sites.google.com/norman.k12.ok.us/digbreakouts/digital-breakouts?authuser=2
- Epidemic Outbreak. (n.d.). Retrieved from http://bit.ly/exponentsbreakout
- Exploring Exponents. (n.d.). Retrieved from https://www.youcubed.org/tasks/exploring-exponents/
- Izzo, D. (2007, July 29). Bacteria Growth. Retrieved from https://www.youtube.com/watch?v=gEwzDydciWc
- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505d6f2
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