# 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 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—Can You Save the World in Time - Spanish.docx
- Components of Exponents—Can You Save the World in Time - Spanish.pdf
- Components of Exponents—Can You Save the World in Time.docx
- Components of Exponents—Can You Save the World in Time.pdf
- Lesson Slides—Can You Save the World in Time.pptx
- Muddiest Point Exit Ticket—Can You Save the World in Time - Spanish.docx
- Muddiest Point Exit Ticket—Can You Save the World in Time - Spanish.pdf
- Muddiest Point Exit Ticket—Can You Save the World in Time.docx
- Muddiest Point Exit Ticket—Can You Save the World in Time.pdf
- Rules of Exponents—Can You Save the World in Time - Spanish.docx
- Rules of Exponents—Can You Save the World in Time - Spanish.pdf
- Rules of Exponents—Can You Save the World in Time.docx
- Rules of Exponents—Can You Save the World in Time.pdf
- You Found the Cure—Can You Save the World in Time - Spanish.docx
- You Found the Cure—Can You Save the World in Time - Spanish.pdf
- You Found the Cure—Can You Save the World in Time.docx
- You Found the Cure—Can You Save the World in Time.pdf

## Materials

- Lesson Slides (attached)
- Components of Exponents handout (attached)
- Rules of Exponents handout (attached)
- You Found the Cure!
  handout (attached)
- Muddiest Point Exit Ticket (attached)
- Computers/Laptops or other internet-connected devices

# Engage

Start the attached **Lesson Slides**, introducing the lesson and the Essential Question on **slide 2**: *"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 5**. 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.

**Embedded video**
https://youtube.com/watch?v=gEwzDydciWc

Lead a whole-class discussion on the students' "I Notice..." and "I Wonder..." statements. You can use **slide 6** to record observations for the class to see. This will help students create a background story and visual reference 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 attached **Components of Exponents** handout and move to **slide 8**. Group students in pairs to complete the handout.

### Teacher's Note: Completing Handouts

It is recommended that students complete the Components of Exponents handout before the Rules of Exponents handout. This allows for misconceptions about exponents to be clarified before students explore their rules.

Display **slide 10**. The attached **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 visual notation. Use **slide 11** to record students' observations about patterns they say in exponents.

### 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.

After the Explain for Components of exponents, move to **slide 13** and have students divide into pairs and complete the Rules of Exponents handout.

The attached **Rules of Exponents** handout allows students to discover the rules for operations with exponents. Following the example given, have students 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.

### Teacher's Note: Lesson Sequence

After students have completed the Rules of Exponents handout, skip ahead to the Explain for Rules of Exponents.

# Explain

**Explain for Components of Exponents:**

Display **slide 20** and introduce the 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.

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 if needed. Each pair will need Chromebook, iPad, computer, or another device to access the Epidemic Breakout. The weblink is also on slide 22.

### 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 the Digital Breakouts 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 attached **You Found the Cure!** handout to each pair. Students should enter the code, note where they found it, and explain how they solved 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 at the next opportunity.

## Resources


- Digital Breakouts. (n.d.). https://sites.google.com/norman.k12.ok.us/digbreakouts/digital-breakouts?authuser=2
- Epidemic Outbreak. (n.d.). http://bit.ly/exponentsbreakout
- Exploring Exponents. (n.d.). https://www.youcubed.org/tasks/exploring-exponents/
- Izzo, D. (2007, July 29). Bacteria growth [Video]. YouTube. https://www.youtube.com/watch?v=gEwzDydciWc
- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505d6f2
- K20 Center. (n.d.). I notice, I wonder. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f507d1a7
- K20 Center. (n.d.). Inverted pyramid. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f507a918
- K20 Center. (n.d.). Muddiest point. Strategies. https://learn.k20center.ou.edu/strategy/baee4e90c5fa1a7060ca04dd8b003a81