Room Escape 1

Materials and Prep
Room Escape door images, paper, and pencil.

Motivating Question
How can we use this calculator to get out of the "escape room?"

Launch
Start by inviting students to share what they know, if anything, about escape rooms. If some students have been in one, invite them to share a story. If not, share (or make up) a personal story about one.

Then share the following story.

"You might be wondering why we're discussing escape rooms in math class. Well, that's because today, our math class transforms into an escape room! In order to escape, you need to solve three challenges. There's a keypad on the side of the door with a button that reads +3, and another button that reads +7. There's a larger screen over the door that reads 50. There's nothing else in the room. How can you escape?"

Challenge 1. Make 50 using only the +3 and the +7 buttons.

Display the image and give students 1-2 minutes working on solutions.

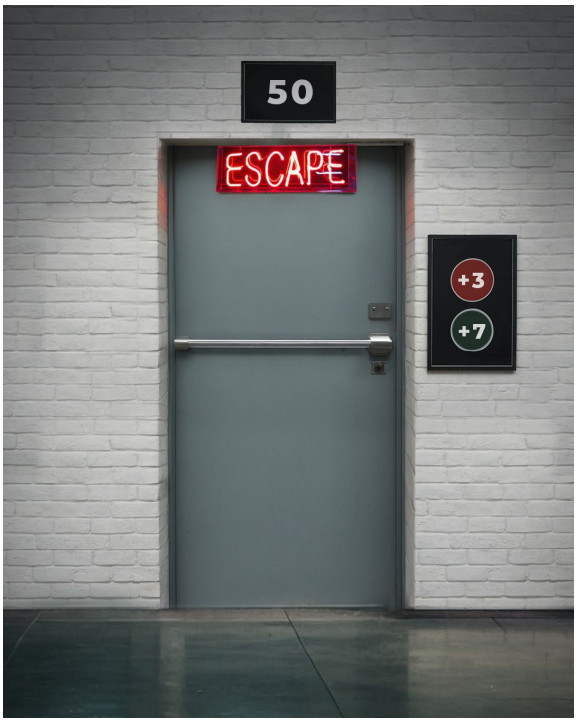
Students might notice that they can press +3 once and +7 once to make a 10. If they repeat those button presses 5 times, they'll make 50. Encourage them to see if they can find it a different way. Another way to make 50 with 2 sevens and 12 threes.

Address how students might write out their answers in a shorter way. For example, $3 + 7 + 3 + 7 + 3 + 7 + 3 + 7 + 3 + 7$ can be written as $5 \times 3 + 5 \times 7$ or $5(3) + 5(7)$.

When students are ready to move forward:

"Congratulations! You made it out of the first escape room. You're on to the next challenge."

(Or continue the story: the screen blinks green. Then the number 50 is replaced by two more numbers: 65, 101. You'll need to get them both to get out.)



Launch Key Points

- You can sell the "Escape Room" idea in different ways, including telling a story. "You wake up in a room. There's nothing there except a door with the number 50 on a screen above it. Next to the door are two buttons, one says +3 and the other says +7. How do you escape from the room?

Work

Challenge 2. Make 65 using only the +3 and the +7 buttons.

Once students have a solution, invite them to see if they can do it in fewer presses of buttons. When groups or pairs of students are ready for the last challenge, offer it to them.

Challenge 3. Make 101 using only the +3 and the +7 buttons.

Look for students who are solving these problems differently. You will use these solutions as examples of equivalent expressions in the closer.

For example, 65 can be written as:

7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 3 + 3 + 3
8(7) + 3(3)

7 + 7 + 7 + 7 + 7 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3
5(7) + 10(3)

Some, but not all, of the ways 101 can be written are:
14(7) + 1(3)
2(7) + 29(3)
7(5) + 22(3)

Prompts and Questions

- Can you write what you did more efficiently?
- How many times did you press buttons?
- Can you reach the target number with fewer presses of buttons?
- It looks like you pushed buttons 15 times. Where can we see that 15 in your work?
- Do you think there are other solutions?

Tips for the Classroom

1. Allow groups to move at their own pace. You can make more challenges for them, or even change the numbers from +3, +7 to +4, +9. How would that change strategies to get solutions?

2. Here's a more challenging extension for students who need more: find the *largest* number that can be on the screen so that no escape would be possible.

3. You can also guide students toward finding multiple solutions and tracking them using a chart, as in the closer below.

Closer

Pose a new challenge to students. Here's one solution to an escape room: Press +7 twelve times and +3 ten times to get 114. The challenge is: how many other solutions can you find? Small groups can tackle this problem.

A table (see below) is a handy way to track solutions. A full set of solutions is listed below.

Sevens	Threes
12	10
9	17
6	24
3	31
0	38
15	3

Prompts and Questions

- Do you see any patterns here that might help you?
- Do you think this pattern holds in general? Why or why not?
- Does this get you all the answers? Why or why not?

Students can share what they notice. A powerful insight here is that given any solution, you can remove seven 3s and add three 7s, or vice versa. This will, in fact, give you all possible solutions.

Choice Time

- Product of War
- Big Pig
- Target Practice
- Challenge Problems

Day 29

Day 29

Day 29

Room Escape 2

Materials and Prep

Room Escape door images, paper and pencil.

Motivating Question

How can we use this calculator to get out of the "escape room?"

Launch

Share the setup, and display the image. (Note: since students will be familiar with the Escape Room problem structure, you could just display the image and let them get to work.)

"Once again, you've woken up in a room with nothing in it except for one door. There's a keypad on the side of the door with a button that reads +9, and another that reads -4. There's a larger screen over the door that reads 60. There's nothing else in the room. How can you escape?"

Challenge 1. Make 60 using only the +9 and the -4 buttons.

Extra Challenge. What's the minimum number of button presses it would take to make 60?

Then give students 3 - 10 minutes to work in pairs or trios.

Students might notice that they can hit +9 once and -4 twice to make 1. If they repeat those button presses 60 times, they'll make 60.

The quickest way to make 60 is to press +9 eight times, then -4 three times.

When students are ready to move forward:

"Congratulations! You made it out of the first escape room. You're on to the next challenge.

(Or continue the story: the screen blinks green. Then the number 60 is replaced by two more numbers: 119, 225. You'll need to get them both to get out.)

Launch Key Points

- Take advantage of students' familiarity with the setup to launch quickly and get them working.

Work

Challenge 2. Make 119 using only the +9 and the -4 buttons.

Once students have a solution, invite them to see if they can do it in fewer presses of buttons. When groups or pairs of students are ready for the last challenge, offer it to them.

Challenge 3. Make 225 using only the +9 and the -4 buttons.

Look for students who are solving these problems differently. You will use these solutions to as examples of equivalent expressions in the closer.

For example, 119 can be written as:
15 (+9 button) - 4 (-4 button) = 135 - 16 = 119

Some, but not all, of the ways 225 can be written are:
26 (+9 button) - 9 (-4 button) = 261 - 36 = 225
33 (+9 button) - 18 (-4 button) = 297 - 72 = 225
37 (+9 button) - 27 (-4 button) = 333 - 108 = 225

Tips for the Classroom

1. There are two additional doors in the Student Workbook. Door 70 (-9, +4) and Door 150 (-9, +4) can be used for future Choice Times.

Prompts and Questions

- Can you write what you did more efficiently?
- How many times did you press buttons?
- Can you reach the target number with fewer presses of buttons?
- Do you think there are other solutions?

Closer

Ask students how the problem would be different if the buttons were changed to -9, +4 instead of +9, -4. Could you make 1 either way? Can you make 1 no matter what the buttons are?

Students can share what they notice. It's interesting to discuss the difference between a solution that involves getting +1, and repeating that move many times, which might involve in a solution requiring hundreds of button presses, and a more efficient (but harder to find) solution requiring fewer button presses.

Choice Time

- Blockout
- Odd Pig Out
- Multiplication by Heart
- Prime Climb
- Challenge Problems

Prompts and Questions

- Can you make 1 no matter what the buttons are?
- How was the problem different when the +/- operations switched?
- What other strategies did you use to solve the problem?

Day 34

Day 34

Day 34

Day 34

Day 34

Room Escape 2
Decimals

Materials and Prep
Room Escape door images, scratch paper, and pencil.

Motivating Question
How can we get out of the "escape room?"

Launch
Share the setup, and display the image. (Note: since students will be familiar with the Escape Room problem structure, you could just display the image and let them get to work.)

"Once again, you've woken up in a room with nothing in it except for one door. There's a keypad on the side of the door with a button that reads +3.9, and another that reads +1.4. There's a larger screen over the door that reads 100. There's nothing else in the room. How can you escape?"

Challenge 1: Make 100 using only the +3.9 and the +1.4 buttons.

Display the image and give students 1-2 minutes working on solutions. A solution is 12(3.9) + 38(1.4) = 46.8 + 53.2 = 100.

When students are ready to move forward:

"Congratulations! You made it out of the first escape room. You're on to the next challenge.

(Or continue the story: the screen blinks green. Then the number 100 is replaced by two more numbers: 200, 501. You'll need to get them both to get out.)

Launch Key Points

- Take advantage of students' familiarity with the setup to launch quickly and get them working.

Work

Challenge 2. Make 200 using only the +3.9 and the +1.4 buttons.

Once students have a solution, invite them to see if they can do it in fewer presses of buttons. When groups or pairs of students are ready for the last challenge, offer it to them.

Challenge 3. Make 501 using only the +3.9 and the +1.4 buttons.

One example to make 200 is for students to double their sequence for 100.

One way to make 501 is to note that:
$5 \times 1.4 = 7$
$2 \times 3.9 + 3 \times 1.4 = 7.8 + 4.2 = 12$

This means you can use 7s and 12s, which are much easier to work with. Working backward, we can take seven 3s from 501 to get 480. This is a multiple of 12, so we can reach it with 12s.

$$7 \times 3 = 21$$
$$501 - 21 = 480$$
$$480 \div 12 = 40$$

Unwinding all the button presses, we have:
$135(1.4) + 80(3.9) = 189 + 312 = 501$.

That's one solution. You can find others by noting that 39 presses of 1.4 are equal to 14 button presses of 39.

Tips for the Classroom

1. Allow groups to move at their own pace.
2. Here's a more challenging extension for students who need more: find the *largest* number that could be on the screen so that no escape would be possible.
3. You can also guide students toward finding multiple solutions and tracking them using a chart.
4. If the numbers 3.9 and 1.4 are too hard to work with, try using 1.5 and 3.5 instead.

Prompts and Questions

- Can you write what you did more efficiently?
- How many times did you press buttons?
- Can you reach the target number with fewer presses of buttons?
- Do you think there are other solutions?

Closer

Pose a new challenge to students.
Create a contest atmosphere where pairs of students try to find the largest whole number that no one else can make with the button presses. Clearly it's impossible to make 2, but is it impossible to make 10? 15?

Give students a time limit to work on the challenge. Then, students make their bid for the largest ungettable number. Students can challenge one another and defend their solutions.

Whoever has the biggest number wins, but everyone gets a chance to see if they can get it first.

Choice Time

- Big Blockout
- Don't Break the Bank
- Challenge Problems

Prompts and Questions

- Do you see any patterns here that might help you?
- Do you think this pattern holds in general? Why or why not?
- Does this get you all the answers? Why or why not?

Day 42

Day 42

Day 42

Room Escape 3

Materials and Prep
Room Escape door images, scratch paper and pencil.

Motivating Question
How can we use this calculator to get out of the "escape room?"

Launch
Share the setup, and display the image. (Note: since students will be familiar with the Escape Room problem structure, you could just display the image and let them get to work.)

"Once again, you've woken up in a room with nothing in it except for one door. There's a keypad on the side of the door with a button that reads +3 ½, and another that reads -2. There's a larger screen over the door that reads 10 ½. There's nothing else in the room. How can you escape?"

Challenge 1. Make 10 ½ using only the +3 ½ and the -2 buttons.

Display the image and give students 1-2 minutes working on solutions.

The most common response is to subtract 2 from 3 ½ to get 1 ½, then multiply times 7 to get 10 ½. Encourage them to see if they can find it a different way.

When students are ready to move forward:

"Congratulations! You made it out of the first escape room. You're on to the next challenge.

(Or continue the story: the screen blinks green. Then the number 10 ½ is replaced by two more numbers: 15, 13. You'll need to get them both to get out.)

Launch Key Points

- Take advantage of students' familiarity with the setup to launch quickly and get them working.

Work

Challenge 2. Make 15 using only the +3 ½ and the -2 buttons.

Once students have a solution, invite them to see if they can do it in fewer presses of buttons. When groups or pairs of students are ready for the last challenge, offer it to them.

Challenge 3. Make 13 using only the +3 ½ and the -2 buttons.

Look for students who are solving these problems differently. You will use these solutions to as examples of equivalent expressions in the closer.

For example, 15 can be written as:

3 ½ + 3 ½ + 3 ½ + 3 ½ + 3 ½ + 3 ½ + 3 ½ + 3 ½ + 3 ½ + 3 ½ - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 = 15

10(3 1/2) - 10(2) = 35 - 20 = 15

One way to reach 13 is to complete the number sequence above, then subtract 2 : 15 - 2 = 13

Tips for the Classroom

1. Allow groups to move at their own pace.
2. You can also guide students toward finding multiple solutions and tracking them using a chart.

Prompts and Questions

- Can you write what you did more efficiently?
- How many times did you press buttons?
- Can you reach the target number with fewer presses of buttons?
- Do you think there are other solutions?

Closer

Pose a new challenge to students.

Is there any whole number you *can't* make with the two buttons? How do you know?

For example, if someone said it was impossible to make 10,001, could you convince them it was possible? Or do you think they might be right?

Let students discuss in pairs, and then as a class.

Here's a hint, if students need it: if there's a way to add 1 using the buttons, you could do it twice to add 2, or three times to add 3. Would that help?

A finished argument that any whole number is reachable might look like this:

Hit 3 ½ twice to get 7, and then hit (-2) three times to subtract 6, leaving 1. Any time you hit this combination of buttons, you add 1 to the total. So, you can make any whole number! To make 10,001, for example, just do the +1 combination 10,001 times. It's not the most direct way, but it would definitely get you there.

Ideally, this argument comes mostly or entirely from the class.

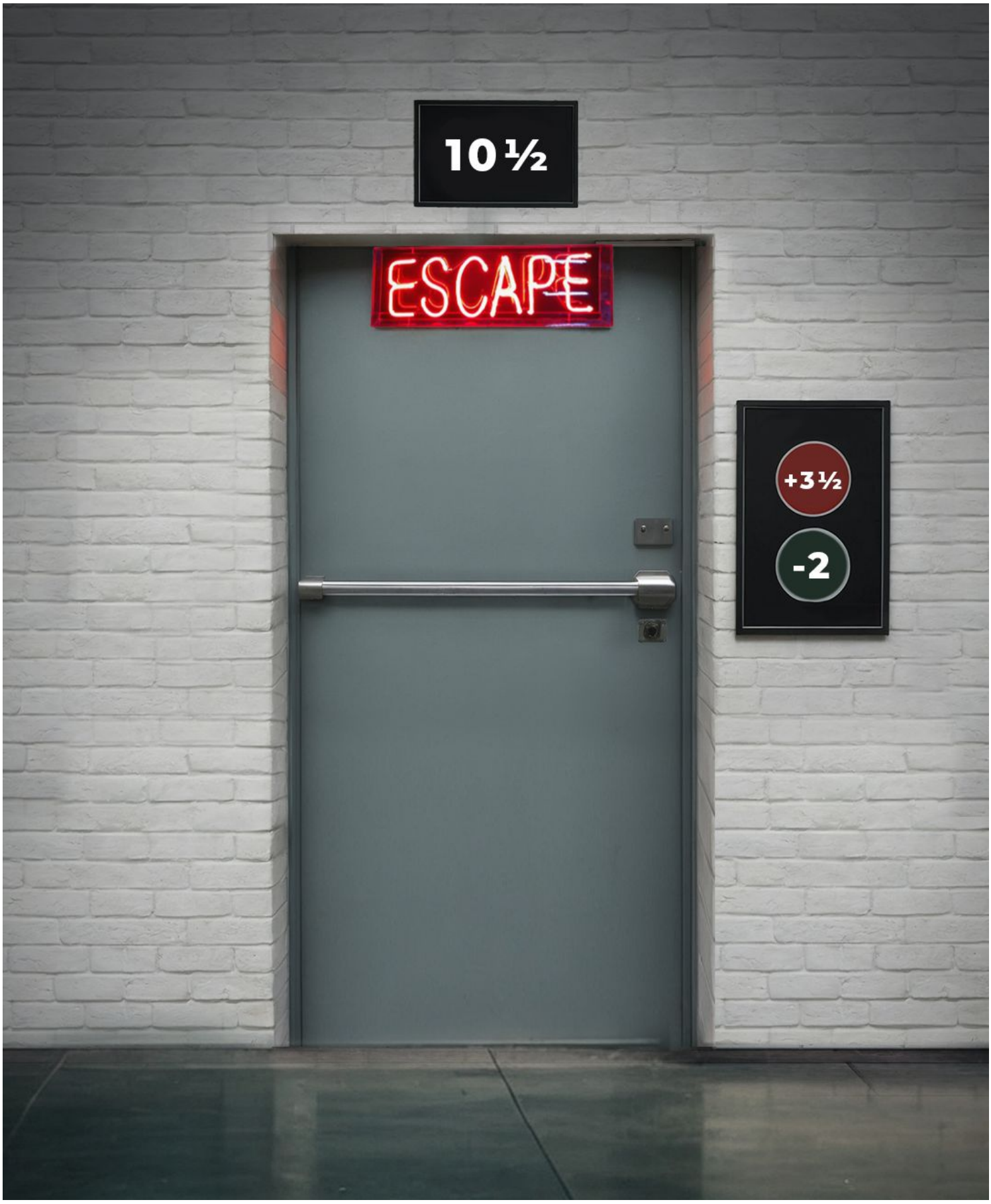
Prompts and Questions

- Do you see any patterns here that might help you?
- Do you think this pattern holds in general? Why or why not?
- Does this get you all the answers? Why or why not?

Choice Time

- Horseshoes
- Prime Climb
- Challenge Problems

Day 48



Day 48

Day 48