**Comparing Real World Functions**

**Section 1**

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| 00:00:00 | TEACHER: You are answering the question, how can you use |
| 00:00:03 | linear relationships to compare real-world situations? You just reviewed different representations of linear functions representing real-world scenarios. Now in this segment, you will be comparing rates of change and initial values of real-world scenarios represented as tables and as graphs. |

**Section 2**

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| 00:00:00 | TEACHER: Let's find and compare initial values of |
| 00:00:02 | linear functions. We're going to compare Fala's total savings after January 1 to Fai's total savings after January 1. Recall that the initial value is also the y-intercept of the function. First, let's find Fala's initial value. First, let's note that the x-axis represents days after January 1, meaning when x equals 0 the |
| 00:00:28 | date is January 1. So the initial value is the corresponding y value when x equal 0. When x equals 0, y equals 0.10, which represents a total savings of $0.10. So on January 1 Fala had $0.10 savings. Now let's find Fai's total savings after January 1. Let's find her initial value. |
| 00:01:02 | So we know that the initial value is the corresponding y value when x equals 0. As you can see from the table, we are not given the value of x equals 0. So first we need to find the rate of change to find the initial value. To find the rate of change, we find the change of the y values. |
| 00:01:19 | So from $0.32 to $0.44, that is a change of a positive $0.12. From $0.44 to $0.56, that is also a change of positive 0.12, and $0.56 to $0.68 is also a change of positive 0.12. Now that we know that the rate of change increases by $0.12, we can find the initial value by taking the value when x equals 5, $0.32, subtracting the rate of change, $0.12 to |
| 00:01:52 | determine that when x equals 0 y equals $0.20, meaning that Fai's initial value is $0.20. Comparing the two initial values, we can conclude that on January 1 Fala had $0.10 in savings, Fai had $0.20 in savings, meaning that Fai had the highest, the largest initial value at $0.20, because $0.20 is more than $0.10. |

**Section 4**

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| 00:00:00 | TEACHER: We found and compared the initial values of Fala and |
| 00:00:03 | Fai's savings after January 1st and found that Fai had an initial savings of $0.20 and Fala had an initial savings of $0.10. Now let's compare the rates of change of the same functions. So a rate of change, or slope, is the ratio of the change in y to the change in x. First, let's find Fala's rate of change. As we can see from the graph, we're given ordered pairs of |
| 00:00:30 | her function. We know that this first point here is 0 and $0.10. And this point here is 20 and $0.40. We can use these points and the slope formula to find the slope, or rate of change, of her function. So recall that slope is found using the two points. I'm going to select 0 and $0.10 as my first point, 20 and $0.40 as my second point. |
| 00:00:59 | So y sub 2, $0.40 minus y sub 1, $0.10 over x sub 2, $0.20 minus x sub 1, 0. Solving $0.40 minus $0.10 is $0.30. 20 minus 0 is 20. $0.30 divided by 20 gives us a slope of 0.015. Now 0.015 in terms of money is about a penny and 1/2. So Fala saves about a penny and 1/2 each day. Now let's find Fai's rate of change, or slope. |
| 00:01:45 | So Fai's information is given in the table. First, let's find the change in y. So $0.44 to $0.56 is an increase of $0.12. $0.56 to $0.68 is also an increase of $0.12. The change in x, we can see that 10 to 15 is an increase of 5. 15 to 20 is also an increase of 5. Now we can use the ratio of change in y to change in x to |
| 00:02:12 | find the slope. So the change in y, we have an increase of $0.12, to the change in x, we have an increase of 5. So $0.12 divided by 5 is equal to 0.024. So in terms of money, Fai saves about 2 and 4/10 of a penny each day. So now we need to compare to determine who will save $1 first. |
| 00:02:45 | Well, looking at the rates of change, 0.015 and 0.024, we can see that Fai is saving at a greater rate because 0.024 is greater than 0.015. But who will save $1 first? Well, looking at after 20 days, Fala is only saving $0.40. But after 20 days for Fai, she's already saved $0.68. So since Fai is saving at a greater rate, we can conclude |
| 00:03:15 | that Fai will save $1 first. |

**Section 6**

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| 00:00:00 | TEACHER: We found and compared the rates of change of Fala |
| 00:00:03 | and Fai's functions of savings after January 1, and found that Fai has a greater rate of change and will reach $1 first. Let's recall the rates of change. So Fala is saving at a rate of 0.015, which is 1 and 1/2 penny each day. And Fai was saving at a rate of 0.024, which is about 2 and 1/2 pennies each day. |
| 00:00:31 | So now, what happens when there is a change of slope in one function compared to the other? So now, what if Fala's savings increased at a rate of 0.03 or $0.03 each day instead of 0.015? Let's write Fala's new rate of change. Now we can see that Fala is saving at a greater rate than Fai. But we now need to determine who will save $1 first. |
| 00:01:03 | We can represent Fala's function as an equation in order to plot more points to graph her function with the new rate of change. So we know the slope as $0.03 each day. So y equals m, our slope, times x plus b, the y-intercept, or the initial value, of $0.10. Now we can find new points. We know that the initial value stays the same. |
| 00:01:34 | So we still have 0 and $0.10. Next [? do a ?] point is when x equals 10, so after 10 days, Fala will save $0.40. Because when 10 is substituted into the function, 10 times 0.03 is equal to 0.3. 0.3 plus 0.1 is the 0.4. So let's plot that new point. x equals 10, y equals $0.40. |
| 00:02:05 | Now, when x equals 20, same thing-- substitute that 20 for x into the equation. We can conclude that y equals $0.70. So plotting that new point-- 20, $0.70-- we can now see Fala's new function with her new rate of change plotted on the graph. So recall that our question is who will save $1 first. |
| 00:02:34 | Well, looking after 20 days, we can see that Fai has saved $0.68. But now, after 20 days, Fala is now saving $0.70. Since Fala has a greater rate of change, she will reach $1 first. Now we can see that changing the slope can change the outcome. |

**Section 8**

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| 00:00:00 | TEACHER: You're answering the question, how can you use |
| 00:00:03 | linear relationships to compare real world situations? We just looked at linear functions of real world scenarios represented as a table and graph. And we also found and compared the initial values and rate of change. And saw what happens when the slope is changed to one function. Now in this segment, we'll also be looking at linear |
| 00:00:26 | functions of real world scenarios. But this time, they will be represented as a scenario and in a graph. |

**Section 9**

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| 00:00:00 | TEACHER: Let's take a look at these two real world functions |
| 00:00:02 | to compare the initial value and rates of change. So Tracy and Colette are on separate planes that are each making the descent to an airport. First, let's find the initial value, starting with Tracy. We know that Tracy's plane started at 12,000 feet. After 10 minutes, she was at an altitude of 7,500 feet. That means that Tracy's initial value is 12,000 feet. Now let's Colette's initial value. |
| 00:00:31 | We know that the initial value is the y-intercept where it crosses the y-axis. And Colette's function crosses the y-axis at 0, 14,000, making Colette's initial value be 14,000 feet. So this means, comparing the initial values that Colette's plane is making its descent at a higher altitude than Tracy's plane. Now let's find and compare the rates of change. |
| 00:00:59 | Tracy's plane started at 12,000 feet, which is represented by the point 0, 12,000. After 10 minutes, she was at an altitude of 7,500 feet, which is represented by the point 10, 7,500. We can use slope formula to find her rate of change. So m equals y sub 2 minus y sub 1 over x sub 2 minus x sub 1. 7,500 minus 12,000 is a negative 4,500. |
| 00:01:36 | 10 minus 0 is 10. Negative 4,500 divided by 10 is a negative 450. Tracy's plane is descending at a rate of 450 feet per minute. Now finding Colette's rate of change, we know the rate of change is the ratio of the change in y to the change in x. We can find that on the graph. So her change in y, she decreases 2,000. |
| 00:02:05 | And her change of x is an increase of 4. So her slope, negative 2,000 to 4. Negative 2,000/4 is a negative 500. This means that Colette's plane is descending at a rate of 500 feet per minute, which is a greater rate than Tracy's rate. Does this means that Colette will be closest to the ground after 16 minutes, since she has a greater rate? |
| 00:02:40 | Or will it be Tracy, since her initial value is 2,000 feet less? Let's compare these functions to find out. So who is closer to the ground after 16 minutes? You can see that each function is represented by its equation. First, let's start with Tracy. Her equation is y equals negative 450x plus 12,000. |
| 00:03:03 | Negative 450 was her rate. 12,000 was the initial value. We can substitute 16 in for x to determine her distance from the ground after 16 minutes. Negative 450 times 16 is negative 7,200 plus the 12,000. So her distance from the ground is 4,800 feet after 16 minutes. |
| 00:03:36 | Now let's use that same method to find Colette's distance to the ground after 16 minutes. So y equals her rate of negative 500 times 16 plus her initial value of 14,000. Negative 500 times 16 is a negative 8,000. Negative 8,000 plus 14,000 is a distance of 6,000 feet. Who is closer to the ground after 16 minutes? Tracy is closer to the ground after 16 minutes, at an |
| 00:04:14 | altitude of 4,800 feet. Recall that Colette had the greater rate of change, but Tracy had the initial value that was 2,000 feet closer to the ground. |

**Section 11**

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| 00:00:00 | TEACHER: It was previously determined that Tracy will be |
| 00:00:02 | closer to the ground after 16 minutes with an altitude of 4,800 feet. Let's look at this example of changing the y-intercept. So what happens when the y-intercept of one function changes? So now what if Colette started from 12,500 feet instead of 14,000 feet? This change is represented in Colette's new graph. |
| 00:00:25 | We can see that the initial value, the y-intercept, is at a 0.12500. The question is, who will be closest to the ground after 16 minutes? Will it still be Tracy? Let's find out. So Tracy's rate of change and initial value did not change. So from the equation y equals negative 450 times 16 plus |
| 00:00:50 | 12,000, it was determined that her distance from the ground after 16 minutes was 4,800 feet. Now let's find Colette's distance from the ground with her new initial value. So Colette's rate of change of negative 500 did not change. So y equals negative 500 times 16, plus the new initial value which is 12,500. Now negative 500 times 16 is a negative |
| 00:01:25 | 8,000 plus the 12,500. Negative 8,000 plus 12,500 is a distance of 4,500 feet. So Colette is now closer to the ground at an altitude of 4,500 feet than Tracy. So change in the y-intercept can affect the outcome of two linear function comparisons. |