Exponential Decay

Video Script

Scene		Full Transcript
1	**Skylar:**	Hey guys, Skylar here. I'm at Jim's to Junk Auto Sales with Jill. Jill is in the market for a set of wheels. Her first car. Now, she sees herself in a sports car, but I think one of these beauties is a little more in line with her budget. In a few years, Jill hopes to trade in her first car for her dream car. When making her selection, she will have to keep resale value in mind and understand how cars depreciate. What will help is a clear understanding of exponential decay. So while Jill goes and kicks a few tires, lets take a drive through decay and get another problem solved.
2	**Skylar:**	Maybe you need to keep looking. To begin, you have to understand that the value of Jill's car will decrease over time. I'll use this car to explain
3	**Voice-Over Skylar:**	Right now the car is worth ten thousand dollars. Ten thousand dollars is one hundred percent of the cars value. Assume the value decreases or decays at a rate of twelve percent or twelve-hundredths per year. This is the decay rate. Over the next year, the cars value will depreciate or decay by twelve percent of ten thousand dollars, which is one thousand two hundred dollars. Ouch! Lets find its value after one year. We'll take one hundred percent of the original value and subtract twelve percent of the original value. So, ten thousand dollars times one hundred percent, or one, minus ten thousand dollars, times twelve percent, or twelve hundredths is equal to ten thousand times one minus twelve hundredths, or ten thousand time eighty-eight hundredths, which equals eight thousand eight hundred dollars, the value one year from now. Twelve percent or twelve hundredths, is our decay rate, but the decay factor is one minus twelve hundredths, which equals eighty-eight hundredths, or eighty-eight percent. The decay factor is the amount of value the car maintains from year to year. It's always between zero and one. Now, lets create a table and graph to estimate the value of the car, two years from now. To find the value at the end of the second year, we take the estimated value of the car after the first year and multiply it by the decay factor of eighty-eight hundredths, which is seven thousand seven hundred forty-four. If we continue the process of multiplying our new value by the decay factor, we predict it will be approximately six thousand eight hundred fifteen dollars by the end of the third year. I'm going to hit the breaks for a sec. Look at this! During the first year, the car value was predicted to depreciate by one thousand two hundred dollars. But, during the second year, the cars value was predicted to depreciate by less than one thousand two hundred dollars. The

		depreciation is not the same from year to year.
4	**Skylar:**	Lets say Jill wants to find out what the value of the car will be in ten years. She could continue to multiply by eighty-eight hundredths for each of the ten years, but as you may have guessed, there is another way. Lets go back to the table.
5	**Voice-Over Skylar:**	We started with ten thousand dollars and multiplied by our decay factor of eighty-eight hundredths. Then, to find the estimated value of the car at the end of the second year, we multiplied our value at the end of year one by eighty-eight hundredths. Remember, ten thousand times eighty-eight hundredths is equal to eight thousand eight hundred. So to help us find a pattern, we're going to replace eight thousand eight hundred, with ten thousand times eighty-eight hundredths. For the third year, we multiply the second year's value by eighty-eight hundredths. Lets write seven thousand seven hundred forty-four as, ten thousand times eighty-eight hundredths, times eighty-eight hundredths. Look at the calculations through the third year, the patterns right there! We repeatedly multiplied by the decay factor. We can go a step further by using exponents. Exponents help us calculate the predicted value for any year, which is represented by "n". We simply take ten thousand, times eighty-eight hundredths, raised to the n'th power. If we want to predict what the cars value would be in ten years, we take ten thousand dollars, times eighty-eight hundredths, raised to the tenth power, which is approximately two thousand seven hundred eighty-five dollars. So if Jill bought this car today for ten thousand dollars, she could expect to re-sell or trade it in for about two thousand seven hundred eighty-five dollars, ten years from now.
	Skylar:	Now, we're talking cars today, but we can calculate decay for any situation if we can identity just two important values.
6	**Voice-Over Skylar:**	The value of the dependent variable when n equals zero, which is a (n=0), and the decay factor which is one minus r (1-r). Why don't we try identifying these two special values in our equation? Remember, a is the value of the dependent variable when n equals zero. Notice in our equation, this value, a, is ten thousand. The second important value is the decay factor. In our example, the decay factor is eighty-eight hundredths. This is one minus the decay rate, r. Lets generalize our result. Instead of using v for value and n for number of years, we can replace these

		variables with y and x. So any exponential decay equation can be represented by, y equals a times the quantity one minus r to the x power (y= a(1-r)^x). There, you're ready to roll! Here's something to remember. The greatest decay always occurs right away, then lessens over time. In the first year, the cars value will decay by a whopping one thousand two hundred dollars! But in the tenth year, we're predicting it will only decrease by about three hundred eighty dollars.
7	**Skylar:**	Turns out, Jill is a pretty true negotiator. As she closes the deal, keep in mind there are a lot of factors influencing actual decay. You should be ready to apply your understanding of exponential decay in similar situations. Problem solved!