Math-in-CTE Lesson Plan

Lesson Title:	**Depreciation (Double Declining)**	*Lesson 01*
Occupational Area:	Finance/Business	
CTE Concept(s):	Depreciation, book value—More specifically double declining. This lesson addresses full years of depreciation only.	
Math Concepts:	Formulas, decimals, percents, exponential decay, linear relationships	
Lesson Objective:	Calculate depreciation expense and book value using double declining balance methods of depreciation and comparing to straight line **(Assumes straight line has already been mastered).**	
Supplies Needed:	Paper, Pencil Graphing Calculators or Excel Worksheet and Internet access	

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
1. Introduce the CTE lesson. "We learned how to calculate straight line depreciation yesterday. "Let's review: "If a $20,000 car depreciates $2500 a year, how much is it worth after 2 years? (Assume $0 salvage value) "Is this really how cars depreciate?" Look at a site like the one listed below, showing the vehicle values decrease earlier in the life of the car. Point out to students the difference between depreciation from	Review the definition of: Current Assets—consumed within a year Plant Assets Plant Assets decrease in value—that decrease in value needs to be recorded as an expense. Accumulated Depreciation—the total amount of depreciation expense that has been recorded since the purchase of a plant asset. Book Value—Original Cost less accumulated depreciation Salvage Value—the estimated amount you can recoup through resell or trade-in when you anticipate you will replace the item. Useful Life—the estimated time, usually in years, you plan to use the asset.

years 1 and 2 and the depreciation between years 2 and 3. http://www.internetautoguide.com/cost-of-ownership//09-int/2004/cadillac/xlr/index.html "We know many assets decline much faster in the first couple years. "Buying a new car is an exciting day for anyone. But have you heard the saying that it depreciates as soon as you drive it off the lot? Just how much is that new car smell worth to you? Can you believe 20%? That means that new $20,000 car is worth less than $16,000 before the ink is dry on the loan! "Here's another example:"	Straight Line—constant amount (in dollars) of depreciation each year In math you learned this as a **linear relationship**. Linear relationships show constant decreases—in this case the dollar amount of depreciation stays the same each year. Double Declining—the value decreases by a percentage of the previous value, declining at a rate twice the straight line. In math, this is known as **exponential decay**. Notice in the internet example that the depreciation total is greater than the original price. They included finance charges and assumed zero salvage. This could lead to a discussion about what depreciation is and isn't and that just because it is on the internet does not make it correct. • *is used to indicate multiplication*.
2. Assess students' math awareness as it relates to the CTE lesson. "If a $500 asset depreciates 25% of its book value (remember book value changes each year), what will it be worth in two years? "This is called double declining depreciation."	**Year1** Original Value – (original X Rate in decimal)=Book Value $500 (1.00 - .25) = 375 or Original Value • (1.00-rate in decimal) = Book Value 500 •.75=375 **Year 2** $375 • .25 375-93.75=281 or 375 • .75=281
3. Work through the math example *embedded* in the CTE lesson.	To assist students, note this: Your math teacher may have referred to the list of book values, 8000, 6400, 5120, etc… as a **Geometric Sequence** because the values are declining by the same percentage

"If you have an asset (car) worth $10,000, salvage value is $500."

Calculate the Rate:

Declining Balance Rate=(100% / # of years) • 2

So a useful life of **10** years:

(100/10years) • 2=20%

Calculate depreciation and book value for five years:

Year	Rate	Depreciation	Book Value
1	20%		
2	20%		
3	20%		
4	20%		
5	20%		

Can you develop a formula for the book value after t years?

This would be very helpful and much more efficient if you were using a spreadsheet.

Year	Rate	Depreciation	Book Value
1	20%	10,000 • .20= **2,000**	10,000 •.80 **=8000** Or 10,000- 2,000=8000
2	20%	8,000 • .20 = **1,600**	10,000•.80•.80=**6400** Or 8,000-1600=6400
3	20%	6400 • .20= **1280**	5120
4	20%	5120 • .20= **1024**	4096
5	20%	4096 • .20= **819.20**	**3276.80**

Book Value=Original Cost • (1.00- rate as decimal)^t

t is time in years

$10,000 \cdot (.80)^t$

Year 1:

$10,000 \cdot (.80)^1$

Year 3:

$10,000 \cdot (.80)^3$

The graph is a representation of **Exponential Decay**—the value is decreasing.

This could also be graphed (use either graphing calculator or a spreadsheet)

Optional Mathematical Connection:

*Note: Students may have used the **exponential decay***

Year	Book Value Double (20%)	Book Value Straight (10%)
0	10000	10000
1	8000	9050
2	6400	8100
3	5120	7150
4	4096	6200
5	3,276.80	5250
6	2,621.44	4300
7	2,097.15	3530
8	1,677.72	2400
9	1,342.18	1450
10	1,073.74	500

formula A = P (1 – r)^t, where A is the Amount after t years, P is the Principal (or original amount), and r is the percent of depreciation written as a decimal. The 1 in the formula represents 100%, so (1 – r) represents 100% minus the percent of depreciation, which is the percent of value the item retains each year.

Explain the graph:

The **Line**ar relationship (the first four letters of linear is line) on the graph is the straight line, representing straight line depreciation. The exponential decay is the curved line, the value decreases exponentially. Notice the variable is in the exponent (time). The exponential graph shows a greater loss of book value earlier in the life of the asset.

Book Value
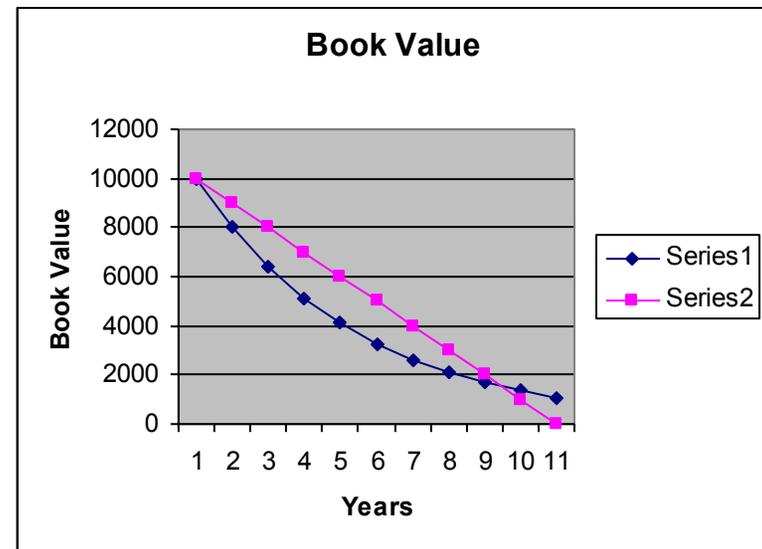
4. Work through *related, contextual* math-in-CTE examples.

(Worksheet is labeled *Double Declining Depreciation*)

"If you have an asset (pizza oven) worth $8,000, salvage value is $1000 and a useful life of 12 years."

Calculate the Rate:

Declining Balance Rate=(100% / # of years) • 2

So a useful life of **12** years:

(100/12years) • 2=16.66%

Calculate depreciation and book value for five years:

Year	Rate	Depreciation	Book Value
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Year	Rate	Depreciation	Book Value
1	16.66%	1332.80	6667.20
2	16.66%	1110.76	5556.44
3	16.66%	925.70	4630.74
4	16.66%	771.48	3859.26
5	16.66%	642.95	3216.31
6	16.66%	535.84	2680.47
7	16.66%	446.57	2233.90
8	16.66%	372.17	1861.74
9	16.66%	310.17	1551.57
10	16.66%	258.49	1293.08
11	16.66%	215.43	1077.65
12	16.66%	77.65	1000

5. Work through _traditional math_ examples. A population of 500 students in a high school decreases by 10% each year. How many students are in the high school after 7 years? After taking 325 milligrams of aspirin, the amount of aspirin in the body decreases by 28% each hour. How many milligrams of aspirin remain in the person's body after 4 hours?	$500 (1.00-.10)^7$ $500 (.90)^7$ (If you do not have an exponent function on your calculator: $500 \cdot .9 \cdot .9 \cdot .9 \cdot .9 \cdot .9 \cdot .9 \cdot .9)$ 239 students In this case 239.19 must be rounded down (truncated). You cannot have a part of a student. $325 (1.00-.28)^4$ $325 (.72)^4$ (If you do not have an exponent function on your calculator $325 \cdot .72 \cdot .72 \cdot .72 \cdot .72)$ 87.34 milligrams
6. Students demonstrate their understanding. You purchased a display case at the beginning of the year for $1600. You estimate a useful life of 8 years and a salvage value of $200. You have decided to use the double declining balance method to calculate depreciation. Use a formula to calculate the book value after 5 years.	$1600 \cdot (1.00-.25)^5$ $\$1600 \cdot (.75)^5$ or $\$1600 \cdot .75 \cdot .75 \cdot .75 \cdot .75 \cdot .75$ $379.69
7. Formal assessment.	

You have started your own carpet company and bought the truck of your dreams — bright red, with the greatest company name in the world on the side. The truck costs $30,000 and has an estimated salvage value of $2,500, and you will only use it four years. Determine the value of the truck at the end of year three.	$30,000 • (1.00-.50)^3 $30,000 • (.50)^3 or $30,000 •.50 •.50 •.50 $3,750

NOTES: