Math-in-CTE Lesson Plan Template

Lesson Title: Oil Viscosities		Lesson # AT-05
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Occupational Area: Automotive Technology		
CTE Concept(s): Determining Oil Capacities and Oil Displacement		
Math Concepts: Interpreting Charts and Graphs		
Lesson Objective:	To teach students the properties and uses of different viscosities of oil and to determine the type and quantity of oil required for an oil change on a specific vehicle.	
Supplies Needed:	Reference on Lubrication and Capacities Recommendations (Valvoline 2010 Lubrication Recommendation & Capacities) Four Test Tubes with 5W-30, 10W-30, 10W-40, and 20W-50 oil, four equally sized ball-bearings or marbles, stopwatch, Worksheet AT-05WS1, "Straight Talk on Motor Oil" video from Valvoline, DVD player, Screen	

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
1. What role does motor oil play in an engine?	A good analogy is that just like a human body can't function without blood, an engine can't run without oil. You may want to pick your own analogy here – anything that can help students understand that oil circulates through the entire engine, making it run smoothly.

2. Assess students' math awareness as it relates to the CTE lesson.	Ask questions about oil and viscosity.
Does anyone know what the word "viscosity" means?	(A. Viscosity is a measure of a liquid's resistance to flow, especially with weights of oil.)
Does anything affect the viscosity of oil?	(A. Temperature: the colder the temperature, the longer it takes a liquid to flow.)
A good way to visualize this resistance to flow or viscosity is to see how long it takes the same weight to get to the bottom of a test tube using different weights of oil. We have four test tubes here filled with 5W-30,10W-30, 10W-40 and 20W-50 oil. When I drop the ball bearing in each tube, we'll start the stopwatch and time how long it takes the ball bearing to reach the bottom. Record the times on your worksheets.	Demonstrate the viscosities of different weights of oil by dropping ball bearings into four different weights of oil and observing. Select a student time how long it takes for the ball bearings in each tube to reach the bottom of the tube and record results on provided worksheet.
	Probe students on why different weights of oil are necessary.
What seems to be the relationship between the numbers in the oil name and the time it takes for the ball bearing to reach the bottom?	(A. The higher the second number, the longer the time.)
Now we are going to complete the graph. We need to include a time scale. The scale on a graph must use the same amount of space to represent the same value increase – in other words, the scale must be evenly spaced. So how do we do this? Generally, unless all the measured values are quite large, we start with zero. Then, a good rule of thumb is to take the highest value you need to show on the scale, round it to a convenient number, and then divide it by the number of spaces you have on your scale. Round this value to a convenient number and this would be how much we would increase the time for each line on the graph. What was the longest time we got in our experiment? What would be a good number to round that to? We have ten spaces on our graph, so if we divide our number by ten, what does that give us? Should we round that value at all to make it more convenient? Now fill in numbers for the time scale, increasing by _____ for each line.	Step students through rounding the highest time to a convenient number (i.e., if the highest number is 97 secs., it would be a lot easier to round it to 100.) When 100 is divided by 10, then each space would represent 10 secs..
Now we will plot our points. Make a dot for each oil weight in the	

appropriate column and at the height representing the time it took the ball bearing to drop. 30 Weight oil will have 2 dots. If we connect the dots from left to right, what does the graph look like? When increasing one value (like the oil weight number), results in another number increasing (time for the ball bearing to reach the bottom), this is called a POSITIVE CORRELATION. What do you think a NEGATIVE CORRELATION would be? What about the first number of the oil weight? Does anyone know what that number tells us? Why are different weights of oil necessary?	The graph should look roughly like a line or a curve that rises to the right. Ask students if this makes sense based on the data they took. (A. When if one number increases, the other number decreases.) (A. The first number is a measure of the flow at cold weather temperatures) (A. Warmer climates would require higher viscosity oil, and closer tolerances inside an engine would require lower viscosity oil.) Show “Straight Talk on Motor Oil” DVD.
3. Work through the math example *embedded* in the CTE lesson. Explain that when performing an oil change on a particular vehicle, it is necessary to determine the correct viscosity of oil to use as well as the correct amount of oil to use. Does anyone here have their own vehicle? What is it? Well, if you wanted to change your oil, you would need to use a manual like this one (“2010 Lubrication Recommendation & Capacities” from Valvoline) and look up your vehicle in it. You would choose your oil based on typical outside temperatures. You would also then look up what the oil capacity of your crankcase is. I have a '99 GMC Sierra with a 6-litre engine. So, look at your manual, which is arranged alphabetically, and find GMC. We need to look for trucks and the year 1999.	Check that students are using their manuals correctly,

When you've located the correct vehicle, you need to determine the correct temperature range for the climate you will be operating in. Notice that this manual recommends 5W-30 at all temperatures, but there are a couple of raised numbers next to the oil name that tell us there is more information available. If we look down and find those numbers below, we see that there is more information about oil types under special conditions. The next step if to determine the capacity of your crankcase which is the same as the VOLUME of the oil we need. Notice for this vehicle, it is 6 quarts.	locating the vehicle they need and also checking for temperature ranges.
4. Work through *related, contextual* math-in-CTE examples. Determine the type and quantity of oil necessary for some other vehicles and other climates. What type and how much oil would you need for a 2008 Ford F150 if you were driving in Colorado, where temperatures are typically 65 – 70 degrees?	(A. 5W-20, all temperatures, VIN Code 5 2004-2010: 7 quarts; all others: 6 quarts. There is also a note that all capacities include oil filter, and that oil level should be rechecked after a refill.)

What if you had a 2003 Kia Sorento and lived in Arizona, where it's typically 110 degrees? What if you had a 2009 Jeep Grand Cherokee with a 4.7- liter engine and lived in Alaska, where temperatures are typically -50 degree	Explain that extra notes contain important information and should be read and any instructions should be followed. (A. 10W-30, 4.7 qts.) (A. 5W-20 or 5W-30, 6 qts.)
5. Work through *traditional math* examples. Look at the graphs at an algebra website and answer the questions provided. We are now going to look at some examples of other graphs you may encounter in your daily lives. http://www.wtamu.edu/academic/anns/mps/math/mathlab/beg_algebra/beg_alg_tut9_bar.htm	The website has a LOT of examples. You may want to focus only on bar graphs and line graphs. (The site includes Venn diagrams and double line graphs as well.) Also, you may want to pick only some of the problems to work through, determining these ahead of time. Some extra questions to ask: What are the units here? Notice how the scales on graphs use the SAME INCREASE for each space. Remind students that the scales on any graph must be divided evenly so that the same amount of space always represents the same value on a given graph. BAR GRAPHS represent values associated with a particular item or category by the height of the bars. These bars may be horizontal or vertical. A LINE GRAPH represents the RELATIONSHIP between two quantities. The one represented on a horizontal axis (the x-axis) is called the INDEPENDENT VARIABLE and

What do “independent” and “dependent” mean? For example, if you are dependent, you RELY on your parents, and the dependent variable is on the Y-axis. The independent variable is the quantity that determines the dependent variable value. In the oil viscosity experiment, the oil viscosity is the dependent variable, because the viscosity determines how long it takes the ball bearing to drop. (The time DOESN’T determine the viscosity of the oil.) The graph we made of the oil weights and the time it took for the ball bearing to reach the bottom of the test tube is an example of a line graph	one represented on a vertical axis (the y-axis) is called the DEPENDENT VARIABLE. (A. “Dependent” means you rely on someone or something else; “independent” means you act on your own, . It is very important to look at the LEGENDS (which explain WHAT is being represented) and the UNITS (which explain how much each number stands for) on graphs. We know that we are dealing with quarts for oil, but the numbers on a graph may represent money, thousands of people, or many other values.
6. Students demonstrate their understanding. Students then return to the shop and practice finding oil weight and capacity on an actual vehicle.	As students are working, ask them to explain how they determined the oil information for the vehicle.
7. Formal assessment.	Students will be asked to explain how they determined the

Students will be required to include the type and amount of oil used when writing a work order during an oil change.	amount and type of oil, and what resource they used to get the information (Aldata, Mitchell's, Identifix, or other).

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