Math-in-CTE Lesson Plan

Technical Mathematics: Math-in-CTE

Lesson Title: Auto Racing Calculations **Writer:** D. Oldham, Coal City High School as adapted from thehenryford.org/education website at https://www.thehenryford.org/education/	Lesson #1

Technical Area: Engineering Technology
CTE Concept(s): Problem solving, speed, distance, design
Math Concept(s): Trigonometry, conversions, physics, motion and energy
CCSS Math Practices & Standards: CC.9-12.A.CED.2 CC.9-12.A.CED.4 CC.K-12.MP.5 CC.K-12.MP.1 CC.K-12.MP.4 CC.K-12.MP.7 **NGSS Standards:** Physics: motion and energy

Lesson Objective:	Design a car that is fast and travels further than the others during a race using the concepts of distance, velocity, acceleration.
Supplies Needed:	• Computers with access to the Internet • Digital projector and screen (preferred) OR printed handouts of Background Information Sheet, Student Activity Sheet and digitized artifacts' images and descriptions [SEE The Henry Ford website PDF: Physics, Technology and Engineering in AUTO RACING at https://www.thehenryford.org/docs/default-source/default-document-library/default-document-library/physics-auto-racing-digikit.pdf?sfvrsn=a072c01_0. • Background Information Sheet for Students 3A: The Study of Motion Using Artifacts [SEE link above.] • Student Activity Sheet 3B: Motion and Energy–Answer Key 3B: Motion and Energy [SEE link above.]

THE "7 ELEMENTS"	TEACHER NOTES (Answer Key)
1. Introduce the CTE lesson. How many people are interested in NASCAR? How about Formula 1 or drag racing? Anyone interested in just plain going fast?	
2. Assess students' math awareness as it relates to the CTE lesson. A. Review/do conversion problems. B. Review/do simple multiplication and division problems. C. Review/do a simple algebra problem.	A. To convert all values to the same units, multiply by an appropriate factor that is equal to 1. Either of the equivalent units can be numerator or denominator to cancel units. **Example: Convert 25 minutes to seconds.** 25 minutes * 60 seconds = 1,500 seconds 1 minute B. Show a multiplication problem. 6 * 2 = 12 C. Sample Algebra multiple choice problem: When $x = 3$ and $y = 5$, by how much does the value of $3x^2 - 2y$ exceed the value of $2x2 - 3y$? **a.** 4 **b.** 14 **c.** 16 **d.** 20 **e.** 50

3. Work through the math example *embedded* in the CTE lesson. 1. Show the formula for Velocity. 2. Calculate distance, speed, & velocity.	1. V=d/t 2. DEFINITIONS: a) Speed is the distance traveled per time. b) Velocity is the displacement per time. **Sample Problem:** A velocity calculation for 8.0 meters north, 8.0 meters east, and 8.0 meters south for a trip lasting 4.0 seconds is: v = d / t = 8 meters/ 4 seconds = 2 meters/second east A car averages 27 miles per gallon. If gas costs $4.04 per gallon, which of the following is closest to how much the gas would cost for this car to travel 2,727 typical miles? **a.** $ 44.44 **b.** $109.08 **c.** $118.80 **d.** $408.04 **e.** $444.40
4. Work through *related, contextual* math-in-CTE examples. A. Car A travels 190 mph and Car B, travels slower racing at 180 mph. How many more seconds will it take Car B than Car A to travel one lap of the 2.5-mile track?	*A. d=v*tort=d/v CarA) t=d/v=2.5miles/190mph=.01316hour Car B) t = 2.5 miles/180 mph =* ***0.01389 hour*** *Time difference = .01389 hr – .01316hr = .00073 hr .00073 hr * 3,600 sec/hr =* ***2.263 seconds and Car A wins.***
B. What is the average velocity of an Indianapolis 500 race car if it takes 2 hours and 40 minutes to complete the 500 miles of the Indianapolis race?	*B. v(ave) = d(total) / t(total) = 500 miles/2.67 hours =* ***187.3 mph***

5. Work through the *traditional math* examples. A. A drag race car travels the quarter mile (402 meters), increasing its velocity from 0 meters/second to 60 meters/second. Calculate its acceleration. D= rate *time B. In an early 1900's race, the pit crew took 10 minutes to get Car A ready to head back onto the track. If the lead car is traveling at 50 mph, what distance would the lead Car B travel while the pit crew worked on Car A?	*d = 30 laps * 1.5 mile/lap = 45 miles* *t=d/v=45miles/65mph=.692hr* 60min/hr = **41.5 minutes*** *d = v * t = 50 mph * 10 min * 1hr /60 min = **8.3 miles***
6. Students demonstrate their understanding. Explain the relationships between velocity, speed and distance in your own words.	Assign this reflective writing task.
7. Formal assessment. A **maximum 3-person team** will design, construct, and test a car that will run faster and farther than any other car in the class and consistently travels that distance. The majority of the points are earned on how far the car moves, how fast the car moves and how close it comes to a wall that you will place at the end of the car's run. You must know in advance how far your car will travel in order to place the wall. The reference point for all measurements is the front edge of the car. **ASSESSMENT TASK:** Calculate the distance and velocity of the car you built and tested.	**The project is worth 200 points:** 50 points for your pretest data tables, weekly reports, and design note books. The race score is calculated using the following formula: • **10 points** if your car moves one full car length • **50 points** come from the distance your car travels. The car that goes the farthest receives all 50 points and each car is scaled from there. The last car will receive 30 points. • **40 points** for being the fastest car. The car that is the fastest will receive all 40 points and each car thereafter is scaled from there. The slowest car will receive 25 points. • **50 points** come from stopping the closest to the wall. The perpendicular

	distance your car comes to rest from the wall will be measured in centimeters. Your predicted distance versus the actual distance your car traveled will be calculated and points will be awarded based upon the percentage you were off. • **50 points** for a well-maintained design notebook. The design notebook reflects the evolution of possible designs you considered, an accurate drawing of the chosen design, discussions of problems your team encountered and how you solved them. NOTE: The **design notebook** must include data from your trials accompanied by interpretation of your comprehensive testing.