**LESSON PLAN OUTLINE- Secondary Mathematics Version**

1. TITLE OF LESSON: Using Speed of Hot Rods to Understand Slope
2. CONTEXT OF LESSON: The students have had experience with time vs. distance graphs and should be comfortable with the characteristics of a graph, such as how the line increases/decreases quickly or slowly, when it remains flat, and the starting point (y-intercept). They should be ready to delve more deeply into the exactness of slope as a rate of change. This lesson should be fun because they get to race cars, make predictions conceptually calculate slope without the use of a formal formula. The formula will soon be derived, hopefully as a student discovery, but students will have something concrete with which to associate the formula.

LEARNING OBJECTIVES and ASSESSMENT:

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| Learning Objective | Bloom | Assessment (Formative/Summative) |
| Students will calculate slope conceptually without aid of formula | Remember | Completion of lab sheet, discussion |
| Student will be able to describe slope as a rate of change | Understand | Group and Class discussion |
| Students will find slope from two points | Remember | Half sheet of 10 questions |
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1. RELATED 2009 VIRGINIA STANDARDS OF LEARNING: A.6 The student will graph linear equations and linear inequalities in two variable, including
2. determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be describes as rate of change and will be positive, negative, zero, or undefined; and
3. writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.
4. MATERIALS NEEDED: CBR (Calculator Based Ranger), calculator, batteries, lab sheet, overhead or Smart Board, several types of cars (remote control, small push car, a car that goes on it’s own after you wheel it back, large Tonka style truck, etc…)
5. PROCEDURE:

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| Time | Mathematical Tasks to be Used,  Teacher Thoughts/Actions/Questions | Anticipated Student Comments, Questions, Actions, and Strategies |
| 5 min  5 min  10 min | BEFORE: Set up CBR. Gather cars together and place in front of classroom.   * Warm up: Coordinate Geometry   worksheet as a review of the coordinate plane and finding ordered pairs followed by a brief discussion. A point is a location on a grid and has a unique name. Refer to Battleship game and to sink your opponent’s ship you must get the exact location. We will be using exact locations on the coordinate plane in our lab today.   * Introduce Hot Rod Lab. Display cars.   “We will be racing cars today to see which car is the fastest and to talk about speed in a new way.”  “When do we normally talk about speed?  “How is speed measured?”  A certain amount of miles traveled in a certain amount of time.  “Let’s say you are on a roadtrip and you have traveled 272 miles in 4 hours. What was your average speed?”  We don’t care about how far you went in four hours, we want to know how many miles per ONE hour.  Discuss R=d/t and how the units remain.  “We will be finding the speed of these little cars, but we will be using different units since we don’t have miles of space in our classroom.”   * Pass our lab sheet. Demonstrate to   class how to use CBR. See included directions for detailed explanation. It needs to be real time, graphing distance in feet and time in seconds. Then race a couple cars to show them how to pull off points from the graph.  Suppose my two points are (3, 1.5) and (5, 2.5). How much time elapsed from the change of 3 to 5 seconds? How much distance was covered in that time? What math problem needs to happen? How can I turn this information into a rate? These questions don’t even need to be answered. Just get them thinking how to approach their lab.  The explanation should be brief and the formula should never be mentioned. Teacher should just get them thinking about what a change in time or distance means. | Students are working individually.  Speeding tickets, speed limits, etc.  Miles per hour is most common  Some students will know to divide without really understanding why. Ask more questions for further explanation.  Students will get in their groups. |
| 5-10 min  20-30 min | DURING:   * Hot Rod Lab   Part 1- Class discussion-Teacher asks for student contribution to answer focus questions. If no one in the class knows the answer, it’s ok. Don’t give them the answer because that question can be discussed after the lab as well.  1) y-intercept is the starting point  2) line goes up when it is going away from the CBR, positive velocity (speed + direction)  3) line goes down when it’s coming toward CBR, negative velocity  For questions 4-6, do a THINK-PAIR-SHARE. These questions require more thought and discussing it first with a neighbor may facilitate a better discussion.  4) All lines should be increasing  5) the car is not moving or it is stopped if there is a horizontal line. It is moving 0 ft per so many seconds.  6) no, bring discussion back to rate. What would a vertical line represent? Traveling x amount of miles in 0 seconds. Time has to elapse to cover any distance. Rule of the universe. Vertical line is an impossible feat.  Part 2 – Small group work  Assign students to their groups (3-4  per group. One racer, one recorder, one working calculator, one helper) Pass out cars to groups, or students may have also brought their own. As a group, they will race six cars and determine a winner. Which car has the greatest velocity? They will then answer concluding questions in their group and be prepared to participate in a whole group discussion.  Teacher will rotate through the groups to help resolve any racing or technical difficulties. Teacher will continue to ask questions and offer hints to help struggling students derive the formula for slope, but only talk about it in words. | Students are sharing what they have learned from Graphs to Events Lab.  Some students may see the connection quickly, others will not. Ask those who “know how to do the math” to keep relating it in terms of the situation. |
| 10-15 min  5-10 min  5 min | AFTER:   * Class discussion - Summary of   Findings. What did students notice as they found the velocity of each car?  Go back to original focus questions and ask for additional insight to those questions.  After students have shared their ideas, pull it together by focusing on the rate as a change in distance over the change in time. Ask for ideas in how we can write that mathematically.  Derive formal formula, but they most likely won’t need it since they studied it conceptually first.  To practice finding slope with just two points, do a THINK AND TURN in groups. Do four times.  1) choose two points  2) find change in y’s  3) find change in x’s  4) make into a ratio and divide  CBR’s need to be put away by the groups.  Each student will be given a half sheet of paper to practice finding the slope from two points. Depending on the time, students can complete prior to leaving or take it home for homework. |  |

1. MEETING THE NEEDS OF ALL STUDENTS: Various CRISS strategies have been used along with multiple representations of the slope. TAPS has also been incorportated.
2. WHAT COULD GO WRONG WITH THIS LESSON AND WHAT WILL YOU DO ABOUT IT? This lesson is dependent on class/group discussions and student discovery. Without those two things happening, it turns into a chaotic lecture. Additional questions may be needed to help students gain confidence. More time can be spent discussing r = d/t
3. CONNECTION TO CTA: From CTA, I was impressed with allowing our students to DO more. That is how I learn a concept, not just from being told what to do. I have used portions of this lesson before and adapted the Hot Rod lab sheet from Deb Crawford, math supervisor at Frederick County Public Schools. I wanted a lesson to be hands on with a lot of student interaction and involvement. And during class discussions, I know it’s easy for some students to zone out and not be “present” so incorporating the Think-Pair-Share and Think and Turn as shown to us by Dan Mulligan will help more students participate in discussions.





