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| **TEAM Lesson Plan Template** | |
| Teacher: Dr. Jason Alexander | |
| Subject/Grade: 8th grade science (or 7th grade mathematics) | |
| Lesson Title: Constant Motion | |
| **STANDARDS** | **Identify what you intend to teach.** State, Common Core, ACT College Readiness Standards and/or State Competencies; Enduring Understandings and Essential Questions. |
| (Mathematics: 7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of  lengths, areas, and other quantities measured in like or different units. 7.RP.A.2.b Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.)  8.PS2.3 Create a demonstration of an object in motion and describe the position, force*(s acting on)*, and direction of the object.  This lesson emphasizes:  Engineering practice: Planning and carrying out Investigations  CCC: Cause and effect; Energy and matter  Learning performance: Students will plan and carry out an investigation to describe the position and direction of an object in motion highlighting both energy & cause and effect. | |
| **OBJECTIVE(s)/Sub-Objectives** | **Connect prior learning to new learning.** Clear, Specific, Observable, Demanding, High Quality, Measurable, Aligned to Standard(s), and Integrated with other subjects, build on prior student knowledge  Student-Friendly (I Can Statement) |
| I can measure the speed of an object.  I can describe the direction of motion of an object.  I can represent the motion of an object using a graph. | |
| **MATERIALS AND RESOURCES** | **Content-related:** Clearly supports lesson objective(s); rigorous & relevant; Incorporates multimedia & resources beyond the textbook. |
| **Activities & Materials**  **Per group**: 1 constant velocity car with two C-cell batteries, 1 meter stick, 1 pencil, 1 student worksheet, calculator, stopwatch. Projector and computer with internet access, white board with markers. Optional: foam board for ramps  Additional worksheet from Arbor Scientific: <https://asc-mag-media.s3.amazonaws.com/datasheet/44-1090_DS.pdf>  **What if the technology is not working?** Skip the video and have two students race (racewalk?) for a short distance across the classroom or in the hallway to develop the notion of speed.  **Routine for distributing materials:** Students should begin class in their groups. One member from each group should come forward to pick up worksheets and a car. Another member should pick up the meter stick. | |
| **ACCOMMODATIONS/ADAPTATIONS** | **Learning styles and interests.** Anticipate learning difficulties, regularly incorporate student interests & cultural heritage; differentiate instructional methods. |
| **Modifications/Plans for Diverse Learners *(NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **Differentiation**  **\_\_x\_\_ Flexible Grouping** The distance measurement task, the time measurement task, operating the car, and recording results/graphing are each different and may be performed by different group members.  **\_\_x\_\_ Other** This activity invites questions from many different levels of Bloom’s Taxonomy. See the questions section below.  **Accommodations**  **\_\_\_ Preferential Seating \_\_\_ Extended Time \_\_\_ Small Group \_\_\_ Peer Tutoring**  **\_\_\_ Modified Assignments \_\_\_ Other**  **Early Finishers:** Have the car travel on different slopes (uphill or downhill using foam board ramps) and calculate the speed. | |

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| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| Present a drag race video such as the following: <https://www.youtube.com/watch?v=epoXb5Gjbik>  What is the race about, physically? The cars travel some **distance**, and they do so in an amount of **time**.  The ratio of distance to time is called **speed**.  Volunteer: Post the “I can” statements. | |
| **INSTRUCTIONAL PROCEDURES** | **Step-by-Step Procedures-Lesson Sequence: Basic to Complex.** Lesson includes visuals, modeling, logical sequencing and segmenting (beginning, middle, ending); essential information; concise communication; grouping strategies; differentiated instructional strategies to provide intervention & extension; seamless routines; varied instructional strategies; key concepts & ideas highlighted regularly. |
| ***Introductio*n**  After introducing speed through a race, ensure that students can write the equation speed = distance/time. Demonstrate the location of the car’s on-off switch. Have students get materials and assign group roles. Instruct them to complete the worksheet.  **Middle**  Monitor students as they complete the activity and record results on the worksheet. Ask questions to prompt them as necessary.  **End/Closure**:    Have students return their cars and meter sticks to a central location. Discuss the observations in terms of cause and effect:  With batteries in, chemical energy is converted to electrical energy which causes the motor to turn the wheels and causes the lights to shine.  With the batteries out, when the car is pushed, chemical energy in the body is converted to motion. The turning wheels cause the motor, now a generator, to turn, producing electrical energy causing the lights to shine.  Some directions make sense only if we can see the one describing the directions: (Someone points “over there.”) or (“to the left”). Other directions make sense without visualizing the observer (“East”) because of a common frame of reference.  **Motivating Students**  \_x\_ Relate to Real World Most students are familiar with cars. This activity connects the motion of an actual car to a graphical depiction.  \_x\_ Verbal Reinforcement The teacher will monitor students’ work throughout the activity to provide reinforcement.  **Presenting Instructional Content**  \_x\_ Lecture/notes There is a brief discussion at the beginning to ensure that students know the speed = distance/time relationship.  \_x\_ Video Used as a hook at the beginning, but may be omitted.  \_x\_ Hands on \_x\_ Guided Practice The worksheet provides guided steps for students to complete the hands-on activity.  ***Instructional strategies:***  ***Input -* Hook (Set)** The video relates this activity to the real world.  **Modeling and Guided Practice *–*** The worksheet lays out steps for students. The teacher will monitor their work and ask questions to prompt them if they are stuck. Ask students to explain why certain units are appropriate for certain quantities (centimeters or inches rather than kilometers or miles for the distance the car travels, minutes or seconds rather than hours for the time the car travels).  **Check for Understanding (CFU) –**  ***What am I doing for students that progress at different rates?***  Encourage students to help each other within their groups. If one group is significantly ahead of another, ask one group to help the other. If necessary, provide help with the algebra (“the algebra” here is essentially unit conversions. These are not the main point of this activity).  ***What do I do if they get it?***  If students handle the activity smoothly have them compare the speed of the car going uphill or downhill to the speed on a level surface (requires a ramp, foam board perhaps).  ***What do I do if they don’t get it?***  Sketch a diagram of the car and meter stick on a white board and demonstrate how to measure the distance travelled over a time interval. | |
| **QUESTIONING/THINKING/PROBLEM SOLVING (embedded throughout)** | **Balanced mix of question types.** Utilizes Blooms Taxonomy/Webb’s Depth of Knowledge; high frequency; purposeful & coherent; require active responses; balance based on volunteers/non-volunteers, ability, & gender; lead to further inquiry & self-directed learning.  **Implement four types of thinking (Analytical, Practical, Creative, & Research-based) & Teach/Reinforce problem-solving types**. Provide opportunities for students to generate ideas & alternatives; analyze, evaluate & explain information from multiple perspectives& viewpoints. |
| **Questioning** These questions will occur throughout the activity as prompts based on groups’ or individual students’ progress.  **Knowledge:**  Are there batteries in the car?  Is the switch set to On or Off?  Are the lights on?  Does the car move?  When the batteries are out of the car and the car is sitting still, are the lights on? If the batteries are out and we push the car, are the lights on?  **Comprehension:**  What units did you use to describe the car’s speed?  What units are used for time in the question [from the worksheet]?  **Application:**  How do we convert 2 minutes to seconds? How do we convert centimeters per second to miles per hour?  Does just moving the car while the batteries are out make the lights come on? Hold the car up and wave it through the air. What has to happen to make the lights come on?  **Analysis:**  If the car travels at 10 cm/sec, then a unit conversion tells us that the car should travel about 22.4 miles in 10 hours. If we had a straight, level, unoccupied track on which a 10 cm/sec car could travel, do you think that it would go 22.4 miles in 10 hours? Why or why not? [ *consider the batteries draining, changes in temperature affecting efficiency, other factors* ]  What provides the energy to turn on the lights when the batteries are not in the car?  **Synthesis:**  What factors should we consider to answer this question: “Will the car go faster when powered by one battery or when powered by two?” [and extra battery provides more energy, but also has more mass. . . ]  **Evaluation:**  **Thinking**    \_x\_ **Practical** –This activity models how we calculate speed from races, whether car races, horse races, or people running track and field events. People and horses do not have speedometers.  \_x\_ **Creative**– The activity begins with students designing a procedure to measure speed.  \_x\_ **Analytical** – Students **compare** quantities in different units and convert units. Students **explain** how the lights function without batteries in the car.  \_x\_ **Research-based** – Students design a process, carry it out, and then communicate the result graphically and in words.  **\*What am I going to do to give Students an opportunity to?**  **1. Generate variety of ideas:**  **2. Analyze problems from multiple viewpoints:**  **Problem Solving *Note: Teach 2 or more types of problem solving (NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **\_x\_\_** **Abstraction** The graph is an abstraction of the motion of the car  **\_x\_\_ Predicting Outcomes** Students have the opportunity to predict what will happen with batteries and without. | |

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| **GROUPING** | **Maximize student understanding & learning** Varied group composition (race, gender, ability, & age); clearly understood roles, responsibilities & group work expectations; accountability for group & individual work; student opportunities for goal setting, reflection & evaluation of learning. |
| * Heterogeneous groups of three or four * Roles. Reader/recorder, Driver, Timer, Measurer * Students will assign roles within the group by writing their names in the appropriate blanks on the worksheet. * Transition. Students should begin class in their groups and remain in the groups throughout. * Product. Students will complete a worksheet and graph. | |
| **ASSESSMENT** | **Formative and/or summative assessment.** A variety of assessments, including rubrics, measure achievement of objectives and informs instruction. |
| ***Assessments: aligned with state stds; measurement criteria; measure student performance in more than 2 ways (project, experiment, presentation, essay, short answer, multiple choice test) (NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **\_\_x\_ Teacher Made Test** A future test may ask students to “Describe a procedure to calculate the speed of a car” or “If a car travels at 12 cm per second, how far will it travel in one minute?”  **\_\_x\_ Worksheet** Students will submit the worksheet for assessment.  **\_\_\_\_ Exit Ticket**  *\****Students should achieve \_\_\_\_\_% mastery of this objective: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | |
| **CLOSURE** | **Reflection/Wrap Up.** Summarizing, reminding, reflecting, restarting, connecting. |
| * ***Review/Summary: wrap up what has been learned and accomplished in the lesson (even if they are in the middle of an exercise, it is still important to summarize to the point where they are now). Ideally involve students in this synthesis.*** * ***Preview for next lesson: link what they did to day with where they are going next.*** * ***Upcoming assignments: remind them of any upcoming assignments.***   ***Today we…. Turn to your partner and…. Let’s review our I Can statements……***  **Here is your exit ticket for today**:  **Follow-up Activities/Extension *These may be designed to create a longer or more intense lesson. For example, if the class is able to cover the material in a lesson much faster than expected, extensions may prove helpful. Extensions may also be useful in various parts of a lesson where the teacher (and class) decides they should spend more time on a skill or topic.***  ***Reflection: You must reflect on every lesson you teach.*** | |

**NOTES:**

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